Future Academic Scholars in Teaching (FAST) Fellowship Program Symposium

May 7, 2014

FAST Fellows 2013-2014:

Alita Burmeister  9:00-9:20
Isis Kuczaj  9:25-9:45
Eileen Rodriguez-Tapia  9:50-10:10
Jonathan Markey  10:15-10:35
Tom Finzell  10:40-11:00
Adam Fritsch  11:10-11:30
Neil White  11:35-11:55
Julie Plasencia  12:00-12:20
Niroj Aryal  12:30-12:50
Indumathy Jayamani  12:55-1:15
Cory Kohn  1:20-1:40
Cynthia Balthazar  1:40-2:00

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Assessing Student Perceptions and Explanations of Microbial Evolution

Alita Burmeister, MMG; EEBB

Mentor: Dr. Jim Smith, Lyman Briggs College; Departments of Entomology & Zoology, EEBB, MSU

Abstract: Evolution is a core concept for biological literacy at the undergraduate level. However, evolution is often overlooked in microbiology classrooms. Evolution instruction especially lags in laboratory-based courses where the inertia is strong due to efforts involved in revising curricula. We used a theme of antibiotic resistance and evolutionary applications in an upper-level undergraduate microbial genetics laboratory course with the goals of (1) increasing students’ ability to explain the details of evolutionary microbial genetics and (2) increasing students’ acceptance and value of microbial evolution. We presented core concepts and applications of microbial evolution during the course’s weekly lecture. One half of the class also completed a three-week E. coli evolution experiment (“treatment” group) while the other half completed only the traditional exercises (“control” group). We assessed the effectiveness of these activities using pre and post attitude surveys and open-ended content questions about microbial variation, inheritance, and selection. Students in both groups highly accepted and valued microbial evolution at the beginning of the semester and had slight, but generally nonsignificant, positive attitude gains at the end of the semester. Surprisingly, scores on the content questions did not improve by the end of the semester for either group. We attribute this in part to a lack of grade-based incentives and students’ seemingly less earnest attempts on the post assessment. Of greater interest to microbial evolution curricula and assessment, we also observed the potential for traditional microbiological instruction to inadvertently reinforce misconceptions and confound definitions of the key terms “variation” and “selection.” To develop suggestions for teachers to avoid these issues, we continue to investigate subdiscipline-specific definitions and language use. This study highlights the persistent need for microbial evolution education tools.

MSU IRB #: x12-137e/ APP# i040365
Does practice mean progress? Assessing Student Scientific Reasoning in Relation to Taking a Reformed Introductory Biology Course.

Isis Kuczaj, Department of Fisheries and Wildlife

Mentor: Dr. Charles “Chuck” Elzinga, Department of Biological Sciences, MSU

In 2009, the BioScience program at Michigan State University reformed its lab courses moving from a traditional “cookbook” style method to an “inquiry-based” approach. The redesigned BS172 Organism Biology Lab now includes a series of inquiry-based labs and a group research project (GRP) learning experience whereby small groups (3-5) of students practice the scientific method by conducting 8-10 week research projects to answer a self-generated research question. Students work through the scientific method and experimental design process through a series of assignments (literature search, project proposals, etc.) which provide a scaffold approach for teaching these processes. Given that increasing scientific literacy remains an overarching goal of the Biological science program, a better understanding of student gains in relation to course completion is warranted. Therefore, our objectives are to:

1. Assess and compare levels of experimental design ability of students at the beginning and end of taking an introductory biology course (lecture, lab, or lecture and lab simultaneously).

2. Examine differences in group profiles that may influence results (GPA, major, gender, TA, lecturer).

We used the Experimental Design Ability Test (EDAT-Sirum & Humburg 2011) to measure how experimental design ability changes over time for students enrolled in: 1)BS162 Organisms & Populations, a biology lecture course, 2) BS172 Organismal Biology Lab, and 3) BS162 & BS172 - where students are dually enrolled in the courses. Differences between pre- and post- EDAT scores will be calculated for each group and differences among groups will be examined. Demographic covariates will also be evaluated to determine the relative contribution of these factors to overall differences in EDAT scores for each of the groups. A better understanding of how experimental design ability changes during the time when students are participating in introductory biology lab is essential for responsible curriculum decisions in this course. If the learning activities of the restructured lab do not appear to be aligned with their learning objectives (to improve student scientific literacy by practicing the process of science), perhaps their use and/or current design should be examined so that we can make the best choices to help students become scientifically literate citizens.

This work is in compliance with the policies and has the approval of the Michigan State University Human Subjects Review Board. IRB #: x13-1227e; approved January 8, 2014.
Assessing the Impact of Problem-based Learning in Enriching and Conceptual-Change Learning in a Student Population Taking an Introductory Course of Neurobiology.

Eileen S. Rodriguez-Tapia, Neuroscience.

Mentor: Dr. Lynwood Clemens, Department of Zoology

Background: Identifying the condition of prior knowledge in students, before instruction, is a critical step in the process of learning complex material. Prior knowledge in students can exist in three different conditions: missing, incomplete, and in-conflict. Learning of complex material can be conceived as an enriching process when prior knowledge is missing or incomplete. However, learning can be conceived as a conceptual-change process when prior knowledge is in-conflict with the to-be-learned material.

Goals: This project has two main goals. First one is to identify the condition of prior knowledge in students about core concepts of neurobiology. Second one is to evaluate how a problem-based learning (PBL) approach impact both types of learning: enriching and conceptual-change. Methods: Neurobiology 402 was chosen to conduct this study because this course is taught using a PBL approach and it is an introductory course to complex core concepts of neurobiology. In order to describe the condition of prior knowledge and assess the effect of instruction in learning, students answered a concept inventory (CI) at the beginning (pre-course) and at the end (post-course) of the academic fall semester. The CI contained 16 open-ended questions, each addressing a particular core-concept of neurobiology.

Results: For the purpose of this presentation we focused on questions addressing neuronal communication and 2 of the most common misconceptions in neurobiology. Pre-course CI revealed that more than 50% of the students had incomplete prior knowledge about concepts related to neuronal communication. Post-course CI results suggested that PBL caused enriching learning in approximately 40% of these students. Analysis of responses of the pre-course CI questions addressing two of the most common misconceptions revealed that 93% of the students had in-conflict knowledge about the percentage of the brain that people use on a daily basis and about sensory perception. Post-course CI results showed that PBL produced conceptual-change learning and revision of false beliefs only when students were learning the concept of sensory perception. Here, 40% of students with false beliefs were able to revised and replaced the misconception with correct knowledge.

Conclusions: This data suggest that PBL teaching approach is somewhat effective at fostering understanding of students about core-concepts of neurobiology. After careful re-evaluation of the questions contained in the CI we concluded that most of them need to be revised in order to target knowledge and learning of students in a more reliable manner. The revised questions will be administered to students taking the same course and impact of PBL on their learning will be re-evaluated.

MSU IRB #: x14-284e; i045805.
Investigating How Students Integrate Knowledge of Gene Architecture, Gene Expression, & Mutation

Jonathan Markey, Department of Plant Biology

Mentors: Dr. Diane Ebert-May, Department of Plant Biology, MSU; Dr. Mark Urban-Lurain, CEER, MSU

Genetics is a difficult subject for many undergraduate students to master. Reasons for this include the need to transfer knowledge between macroscopic, microscopic, and molecular levels of biology and the need to understand how multiple components of a system relate and interact together. A thorough grasp of genetics is required to understand other important biological processes, such as evolution, and is therefore an important component of a biology-major's education. This research investigates students' conceptual understanding and integration of the concepts of gene architecture, gene expression, and gene mutation when solving a genetics-related problem. As part of the research, I will evaluate students’ written responses to an open-ended exam question that integrates these three concepts.

Data were collected from ZOL341 courses from fall 2012 (F12), spring 2013 (S13), & fall 2013 (F13). Student responses were qualitatively coded and analyzed using a holistic rubric. Additionally, I will administer the item to sections of ZOL341 from spring 2014 (S14). Upon analyzing the S14 data, I will select students from these sections, based on their response to the question, for think-aloud interviews that will examine the depth of their understanding. These interviews will also provide some validity to the rubric used to score the exam item, since the assumptions made about student thinking while developing the rubric can be confirmed by students’ responses. Interview transcripts will be qualitatively coded and analyzed using a grounded theory approach, to determine what themes are evident in the student responses.

Upon analysis of the F12, S13, and F13 data (n=778 responses), only 36.6% of the students (n= 285) were able to answer the question with complete accuracy and correctness. 17.7% of the students (n=138) were able to answer the question correctly; however their response had one or more errors or misconceptions. 32.3% of the students (n=251) answered the questions incorrectly while producing a similar explanation for their claim. Furthermore, this uncovered misconception is not just prevalent in the lower performing students in the class. Grouping students into quartiles based on their written final exam score shows that even a substantial proportion of the better performing students answered incorrectly while producing the common error in their explanation. In conclusion, these results add to the body of knowledge about common student misconceptions in genetics and may aid in the design of instructional strategies that address this specific student misconception.

MSU IRB#: 14-088
Studying the Preconceptions and Beliefs of Learning Assistants in a Pedagogically Unbiased Environment

Thomas Finzell, Department of Physics & Astronomy

Mentors: Dr. Brian O’Shea and Dr. Danny Caballero, Department of Physics & Astronomy

Just as students come into classrooms with preconceptions about the subject to be taught, Teaching Assistants and Learning Assistants (TAs/LAs) come into their roles as instructors with beliefs about teaching. Previous research studies have looked at TA/LA beliefs through a post-training lens. The TAs/LAs in these studies were given training and instruction on how to interact with students, such that their behavior was more of a reflection of the training than of their own beliefs. I present here the first study, a pilot program, that looks at LAs, working in the Michigan State University physics help room, with no formal training or instructions on how to interact with students. The help room was observed on multiple occasions and a framework, identifying different facets of LA-Student interactions, was used to code the observed interactions. A follow up interview was conducted with one of the observed LAs that looked at how they viewed their role within the physics help room. The results of the observations and interview give us a window with which to view the practices and beliefs of an LA who is the transition period between student and instructor.

MSU IRB #: x14-054e; i045317
How can clicker questions be implemented in a lecture for improved learning in Modern Physics?

Adam Fritsch, Department of Physics and Astronomy

Mentor: Dr. Danny Caballero, Department of Physics and Astronomy, MSU

One of the most important courses an undergraduate physics major takes is Modern Physics. It is often students’ first formal introduction to both special relativity and quantum mechanics, material that is not only vital to the students’ understanding of physics in today's world, but also the type of study that requires approaching science from a different mindset than they’ve been taught in high school and their early college careers. In Spring 2014, with the permission of lead instructor Dr. Norman Birge, I worked to test teaching methods on how to best present and discuss these new physical concepts to his students in Modern Physics at MSU. At Dr. Birge’s suggestion, I designed and implemented clicker questions for lectures on a specific topic of importance in the course, in this case, the Bohr model of the atom. At the end of the course, a concept inventory was given, as well as the course’s final exam. Comparison between this year’s students and last year’s on the final exam, specifically on the topic covered by the clicker questions, will be investigated. The concept inventory will also be studied to see how well the students performed on various topics.


Non Human Subject Research; MSU IRB #: 14-316, April 4, 2014
**Student Metacognition in the Biological Sciences**

Neil A. White, Biochemistry and Molecular Biology, Michigan State University

Mentor: Dr. Cori L. Fata-Hartley, Department of Microbiology & Molecular Genetics, Michigan State University

Metacognition is thinking or learning about learning. It includes everything from deciding what to learn, to selection of strategies, and to assessment of if learning took place [1]. In our study, we are attempting to aid students in these critical components of learning and at the same time, gain general insights as to how students are learning Biology. The main focus of our study is on exam preparation. We are examining selection of study activities, the reasons for selection of those activities, and time allocation of students, to build a profile of what students are doing for exam preparation. We are also investigating general metacognitive topics to better understand how students view learning Biology. In the past, we implemented open-end surveys in a small class with the purpose of designing a series of close-ended surveys. We have very recently finished administering that series of close-ended surveys to three sections of BS 161: Cells and Molecules. Currently, we are looking at responses of what students are doing to learn Biology and their views on learning Biology. We are correlating that data with exam performance. Preliminary results show interesting correlations between students’ answers to general metacognitive questions and exam scores. We are planning to use these results to inform an effective, future intervention to aid student learning by enhancing metacognition.

MSU IRB#: x10-806

Assessment of Cultural Knowledge and Skills Transfer in Dietetics Education

Julie Plasencia, MS, RD, Department of Food Science and Human Nutrition

Mentor: Dr. Lorraine Weatherspoon, PhD, RD, Department of Food Science and Human Nutrition, MSU

As the population in the United States becomes more ethnically diverse, there is a strong need for health care professionals, especially Registered Dietitians (RD), to acquire cultural competency skills before they enter the workforce. Currently, most didactic programs in dietetics have a “cultural foods” course to meet cultural competency education standards and student learning outcomes. It is known that assignments with cultural competency learning objectives increase student’s knowledge on diverse cultures,1,2 however, little is known if knowledge from these types of courses transfers into higher level application type course, such as nutrition counseling. This study examines how cultural competency skills and knowledge from cultural foods course transfer into an applied setting such as a capstone level course with a focus on patient counseling.

A cultural competency rubric (CCR) was developed based on cultural foods course cultural competency learning objectives. The rubric was used to assess if and how knowledge and skills taught in a cultural food course were retained and applied to case study assignments in a capstone course. Two sets of questions addressing students’ cultural competency knowledge were included in two consecutive quizzes, one of which included the term “culture” and the second did not. CCR scores were compared between those who had completed the course (n=37; 71%) versus those who had not (n=15; 29%).

Independent t-test analysis showed that students who completed the cultural foods course had a significantly higher mean CCR score of 2.73 compared to those who had not taken the course, mean CCR score of 1.2; p<0.019. We can conclude that students who completed the cultural foods course were more likely to apply cultural competency knowledge and skills without explicit elicitation compared to those who had not completed the course; indicating learning transference. The results of this study indicate that students benefit from taking a cultural competency course prior to an applied nutrition counseling course, capstone course. This ensures that the students have the skills and knowledge ensuring proper preparation to serve a diverse population. In addition, evidence of skills and knowledge transfer on cultural competency are important for maintaining education standards for program accreditation.

MSU IRB#: x14-076e


Enhancing Student Accountability to Outside-Classroom Activities

Niroj Aryal, Department of Biosystems and Agricultural Engineering

Mentor: Dr. Dawn Reinhold, Department of Biosystems and Agricultural Engineering, MSU

Students’ motivation, the extent to which students show attention and effort in learning activities, is highly correlated with performance. While there are several studies that focus on motivation of students in general, this research focuses on motivation of students towards outside-classroom activities such as doing assignments, reviewing homework solution, feedback and rubric, preparing for class, and thinking actively about the problems. The learning of students can be limited if enough responsibility or accountability is not shown from students, especially with multitudes of distractions around. In addition, new instructional techniques such as flipped, blended, and online classrooms place high responsibility on students to learn outside of classroom.

This project evaluated students’ motivation towards engagement in learning activities with the focus on outside-classroom activities in three different junior level courses (A, B and C) in Biosystems Engineering. The research also compared the motivation of the group of the students common in these three courses and evaluated the structuring and teaching approaches that were used in each course. Surveys were done using questionnaires modified from Pintrich et al. 1991 (A manual for the use of the Motivated Strategies for Learning Questionnaire). The first survey, done during the middle of the semester, included 5-point Likert scale questions, multiple choice questions and open ended questions on intrinsic and extrinsic goal orientation, learning beliefs, cognitive and metacognitive strategies, resource management, and general learning preferences. The final survey was carried out at the end of the semester to evaluate the perceptions of students on the effects of teaching methodology and activities on performance and motivation for outside-classroom activities.

Initial results suggest that students’ motivation differed for courses, with motivation of 2.94±0.2 (n=27), 4.52 ±0.11 (n=21) and 3.13 ±0.48 (n=13) (p<0.001, 5 being the highest motivation) for course A, B, and C, respectively. Course structuring, and pedagogical methods affected the students’ motivation. While the analysis of performance in each course is underway, the approaches identified can potentially enhance students’ motivation for engagement in learning activities outside of classroom in future classes.

MSU IRB#: x14-097e
Development and Evaluation of a Concept Inventory for Material Balance

Indumathy Jayamani, Department of Civil and Environmental Engineering, College of Engineering

Mentor: Dr. Susan J. Masten, Department of Civil and Environmental Engineering, College of Engineering, MSU

The aim of this study is twofold: 1) to develop a mass balance concept inventory that could be used to assess student learning of these concepts, 2) to evaluate the concept inventory and collect additional alternate conceptions. Material balance is a core concept in environmental engineering that students are expected to learn and use throughout their degree program and afterwards. This concept is usually introduced in sophomore level classes but is applied in context through upper level classes. However, past experience in upper level environmental engineering classrooms show that students have difficulty in mastering these concepts. A previous study identified several alternate conceptions that students have that hinder them from mastering these concepts. A concept inventory with questions, correct answers and distractors that denote specific alternate conception was developed based on the results of a previous study conducted by the author in a senior level environmental engineering classroom. The mass balance concept inventory was coded as an online survey on SurveyMonkey®. The survey was then sent to all students who have previously enrolled in any upper level environmental engineering course dealing with mass balance. Seventy-nine students were in the study population, of which 49 were currently enrolled in environmental engineering classes. Nineteen participants started the survey, but only ten of these students completed the survey and only those ten were considered for further analysis. A preliminary analysis of the data showed that students have difficulty understanding the differences between the operating conditions of the two ideal reactors and the assumptions behind their mathematical model. They also have difficulty in relating the various parameters such as flow rate, volume, and detention time. These results show the importance of teaching methods that explicitly mention, 1) the assumptions in mathematical modeling of material balances, b) the implication of ignoring these assumptions while applying these models and, c) the usefulness of units in relating various parameters.

MSU IRB #:i045532
Personality and the Acceptance of Evolution among Undergraduate Populations

Cory Kohn, Zoology Department; Ecology, Evolutionary Biology and Behavior Graduate Program; BEACON Center for the Study of Evolution in Action

Mentor: Dr. Louise Mead, BEACON Center for the Study of Evolution in Action, MSU

Evolutionary biology is of special importance for targeted science education efforts. This requires our understanding of population differences in factors affecting students’ acceptance of evolution (AoE). A recent study has suggested the key personality trait openness to experience (OtE) has greater explanatory potential than others. Characterizing OtE, AoE, their relation within and between undergraduate populations, and associated semester change will aid in assessing instructional effectiveness.

Openness to experience and evolution acceptance were assessed using the Measure of the Acceptance of Evolution (MATE) and the OtE subset of the Big Five Inventory (BFI). The MATE has been extensively used with undergraduates. Some studies have used it to evaluate the effectiveness of instruction or to characterize and compare multiple populations; however, few have accomplished both, and none with satisfactory statistical robustness. To address these research objectives, we surveyed a range of evolution-related courses, sampling both at the start and end of the semester to additionally characterize semester change. Students enrolled in courses that generally draw the following populations were surveyed: non-STEM (ISB 202, two sections), introductory STEM (BS 162, two sections), and upper level biology (ZOL 445, one section), with approximately 100 students surveyed per section. These populations were presumed to differ in their exposure to and content knowledge of evolution, and in their degree of science background and interest. Additionally, as suggested by previous studies, these populations might co-vary with respect to OtE. This hypothesis suggests a few specific predictions, e.g. STEM students will have increased OtE and therefore greater semester change in AoE. Other data collected include students’ majors, science and evolution exposure, etc; course sections’ focus on evolution, etc; and instructors’ experience, and familiarity with and use of student engagement and reformed teaching practices, etc. Thus, potential reasons can be suggested for between-section differences in AoE change across the semester.

We are currently conducting statistical measures to explore the multitude of relevant factors. Potential contributions include these characterizations, comparisons, and suggested connections with course section differences. Teaching implications might include supporting/questioning instructors’ use of the MATE, and suggestions of sufficiency of science content instruction alone for (non-)STEM students.

MSU IRB#: x13-1218e, January 9, 2014
The Mathematic Achievement Gap and College Completion

Cynthia Balthazar, Department of Community Sustainability

Mentor(s): under development

Students graduating from high school in many school districts throughout the United States are entering college and finding that their preparation for college mathematics is lacking. A California study comparing completion rates of post-secondary degrees to passing of their college math requirement within the first two years of school, found that of students who failed to complete math requirements in the first 2 years, only 21% went on to receive their degree (Moore & Shulock 2010). Completion of college math requirements in the first 2 years is critical. This project is being conducted to investigate the needs of the students who fall into this gap at Lansing Community College (LCC), and to use the gathered information to establish a support group for these students that will assist them in the completion of their mathematics requirements. All students receive a pre-test (placement test) in mathematics upon entrance to LCC, which will be used as a baseline and for identification of the target population. The identified students will be invited to attend a focus group for the investigation stage. Qualitative analysis of the focus group transcripts using coding for common themes will be used to define the areas of needed support. Overall questions to seek answers to are: Do students identify within themselves this gap? Do they understand that they have the power to address the gap by taking ownership and seeking out support? And, do students who seek support, find the success that they need? Students enrolled in remedial mathematics courses will be invited to attend a support group that will be tailored to the needs of the students. At the end of the semester, final exam scores and course grades will be used for post-test scores and summative interviews with support group participants as well as target group individuals who did not participate in the support groups will be used to evaluate the success of the project. Analysis will include that of the quantitative data using SPSS version 22.0 and qualitative analysis through coding of interview transcripts.

MSU IRB #: project under development

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