FAST (Future Academic Scholars in Teaching) Fellowship Program, 9th Annual Symposium

May 11, 2015

2014-2015 FAST Fellows:
9:00-9:20—Katy Meyers Emery
9:20-9:40—Kari Dammerman
9:40-10:00—Amber Goguen
10:00-10:20—Joanne Philhower
10:20-10:40—Eric Bruger
10:40-11:00—Alyssa Burkhardt
11:00-11:20—Wouter Brink
11:20-11:40—Trisha Smrecak
11:40-12:00—Kateri Salk
12:00-12:20—Julie Plasenciak
12:20-12:40—Markus Downey
12:40-1:00—Andy Krause

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Digital Digging: The impact of technology on learning and digital confidence in an undergraduate archaeology course

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Mentor: Dr. Melissa McDaniels; IRB #: x15047e; i047846

Digital literacy, defined as the skills and knowledge to create, evaluate, critically apply, navigate and leverage digital tools for professional use, is increasingly important within our modern Western society. Studies show that 77% of employers expect college graduates to have internet-based computer skills and will independently learn new skills as technology changes. Despite this, universities do not prepare students with the necessary digital competencies or build student confidence. By embedding digital tools into our course curriculum, we can improve students’ digital literacy and confidence. This research examines digital literacy perception and digital abilities of undergraduate students in an introductory archaeology course (n=187), and assesses whether integration of new technology into the classroom improves learning and confidence.

The first objective was to assess the myth that current undergraduates are considered digital natives and will therefore innately know how to use technology for learning. It was hypothesized that if students were digitally literate, they would be able to use digital tools to describe and evaluate an archaeological controversy, and that they would learn better using online videos instead of traditional texts. The second objective was to integrate a variety of digital tools into the classroom in order to increase confidence in using social media and technology for learning. To address these two objectives, students were given a preliminary survey on perceptions of their own digital literacy. Next, interventions were implemented: 1) Storify, a digital storytelling tool, was used to examine digital literacy as it required students to locate, organize, annotate and evaluate digital media; 2) quizzes were used to address whether students learned better with video or text, and 3) students had the option of creating and turning in homework through analog or digital methods, such as Popplet, a mind-mapping tool, Dropbox, and Twitter. Finally, a post-course survey was administered to examine changes in perceptions of their digital literacy and attitudes towards technology in the classroom.

Results from the preliminary study showed that students were confident in their ability to use technology and digital tools for learning, but the majority had issues actually using Storify, including not sharing the posts, not annotating the correct materials, citing inappropriate material, not removing the help text, and citing other people’s Storify assignments instead of finding original content. Further, most students perceived that they could identify scholarly resources online, but the majority could not- an issue that was pervasive throughout the course. This research demonstrates a gap between perception and ability. Students were correct in that they perceived they would learn better with digital tools, and were able to provide correct answers more frequently when the material was learned from video or a digital tool. Results from the final survey show that student confidence in their ability to use digital tools slightly declined, which may indicate a better awareness of their abilities rather than actually loss of confidence. However, most were enthusiastic to re- use digital tools from the course for future educational projects, and over the duration of the course, student usage of digital options increased and basic technological mistakes declined.

The implications of this study is that both students and instructors are making assumptions about digital literacy, and demonstrates that the inclusion of digital tools in a non-technical course may have positive impacts on improving students’ understanding of the course content, as well as their digital literacy abilities and confidence.
Using Social Media as a Tool to Enhance Classroom Discussion
Kari Dammerman, Department of Zoology

Mentors: Dr. Mike Jones & Dr. Mary Bremigan; IRB #: x15-100e

Advances in technology have led to a rise in the use of online platforms in classrooms. Although online platforms have been cited as invaluable tools that can strengthen relationships within the classroom and provide additional outlets for student communication, integrating social media platforms such as Facebook and Twitter into classrooms have been less frequent. Educators opposing the use of social media in the classroom have cited these platforms as distractions and inappropriate tools that increase the confusion between personal and professional relationships. However, educators that have used social media in their classrooms have found that student engagement and overall student interest in the course have greatly improved from the use of these platforms.

We assessed: i) whether student engagement in discussion periods differed when discussing course content on a social media platform where students could post anonymously vs face-to-face in a classroom, ii) whether student’s abilities to apply course content differed between the in-class and online discussion periods, and iii) student’s overall willingness to use social media in the classroom. Eleven students in an upper-division fisheries management course were observed during 2 in-class and two online discussion sessions. In-class sessions included student-led presentations of 4 fisheries papers followed by 10 minutes of student-led discussions. During discussion periods, students were assessed on their participation, intellectual content, and speaking and writing skills. Online sessions were conducted in Purdue’s social media program, Hotseat which mimics Facebook and Twitter. During online periods, students were presented with 3 tasks: post 2 prompts about any of the 4 fisheries papers discussed, reply to at least 2 prompts from other students, and complete a post-discussion quiz. At the end of the project, students were asked to complete a post-project survey that assessed their daily use of social media and willingness to use it in the classroom. Due to low participation during the first session, students were also presented with 2 types of incentives to determine sources of motivation in the class.

Participation in the discussion periods on Hotseat was low with <50% of the class completing the 3 tasks during either of the online discussion sessions. Students that participated in the in-class and online sessions did not differ in any of the assessments. However, students often used acronyms and bulleted lists on in-class quizzes versus writing in complete, coherent sentences on the online quizzes. Surprisingly, extra course credit as an incentive did not influence student’s participation. Survey results indicated that the majority of the class enjoyed using Hotseat, but half the class did not feel that social media should be used in the classroom even though they use it on a daily basis. However, half of the students enjoyed the option of having extra time to ask questions about the literature if needed. Results imply that students in this class may not use extra discussion time because it is extra work and not needed at this stage of their education. Students enjoy social media, but see it as a personal platform that doesn’t enhance learning or belong in a classroom. As discussed in the literature and confirmed in this study, integrating social media into any STEM classroom may require breaking down preconceived notions and integrating platforms in a creative manner only when it is appropriate for the course and will complement the desired learning objectives.
The Effects of In-Class Group Work on Student Social Networks External to the Classroom
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Mentor: Dr. Shawn Riley; IRB#: x14-837e

Previous studies on university undergraduates suggest a sense of belonging to a scholarly community is a critical part of the student academic experience. Our research seeks to identify if in-class group work can function to increase the number of connections in a student’s social network. Creating connections through in-class group work is important for non-traditional students (eg. minorities, transfer students) who may not participate in the same out of class activities as others in their department and who may feel more isolated from their department. Often for these non-traditional students the classroom is the only place where they meet peers, thus the classroom functions as a key location to build social relations that can grow outside the classroom, which provide peer support and help build community within an academic department.

To identify the effect of group work on student’s social networks, I measured students friend and peer support networks at the beginning and end of the semester and assessed factors that predict their structure and change throughout the semester. Surveys were conducted at the beginning and end of the semester in a 58 student upper level major required course within the Circle Department (names changed for confidentiality) at a 4-year university (T1=98% & T2=100% response rate). Surveys collected information on student social networks with other students in the classroom, information about their social activities on/off campus, and basic demographic and academic information. Students were also randomly assigned to complete in-class group work at three points throughout the semester, the number of times a student interacted in a group with another student was measured from 0 – 3.

The class was 93% department majors, 52% male, 88% white, and a majority of students considered themselves as seniors. More than 60% of students could be considered non-traditional. On average students rated the sense of community in the department as a 4 on a scale of 1-5, there was no statistical difference between traditional and non-traditional students sense of community. Student’s friend and peer support networks changed from the beginning to the end of the semester. All measured networks increased in density and connectedness, and decreased in fragmentation and the number of isolates from the beginning to the end of the semester. Overall, the social networks of non-traditional students were not different from those of traditional students. Cliques and clusters were present in all networks, but decreased from the beginning to the end of the semester. Additional analysis will discuss the role of group work in modifying social networks. Generally, students enjoyed group work and often mentioned obtaining different points of view as a positive part of the group work experience.

Integrating non-traditional students is of increasing importance for many academic departments as more students are transferring into 4-year universities as upper classmen. Universities are becoming more diverse and actively seek more diversity, they must find ways to integrate non-traditional students into the department community. The Circle Department has a strong sense of community and I found no difference between traditional and non-traditional students social networks. Group work functioned to take advantage of this diversity by introducing students to new ideas and life experiences.
Implementing Formative Assessment Practices in Secondary Mathematics in Two Ways: My Own and My Teacher Preparation Students
Joanne Philhower, Mathematics Education

Mentor: Dr. Sandra Crespo; IRB #x14-873e

My teaching as research project was grounded in the fifth-year secondary mathematics methods courses that I co-taught during the fall and spring semesters. These are Master’s level courses that the pre-service teachers take while completing their year-long student teaching experience (i.e. internship). The two-prong question guiding this project is in what ways my modeling of formative assessment practices in teacher preparation courses informs my own teaching and that of my pre-service teachers. First, I focused on how I implemented and modeled different aspects of formative assessment practices, such as questioning and feedback, in order to improve my own teaching practices. Second, I investigated how we supported secondary mathematics pre-service teachers in developing their beliefs and practices related to formative assessment.

There are multiple data sources, including video-recorded class sessions, surveys, course assignments, and an end-of-the-year interview. Activities and class sessions led by me were video-recorded to allow classification and analysis using an established questioning framework, developed by Boaler and Brodie (2004), for productive whole class discussions. Interns’ course assignments were analyzed to determine the classification types of my feedback, likely using an established framework developed by the Thinking Collaborative group. Interns completed a beliefs survey related to teaching mathematics, which included topics such as assessment and expectations for students, three times during the year (August, December, and May). They also implemented teaching experiments focused on formative assessment practices twice each semester, submitting lesson plans and reflections for each of these activities.

Data collection is on-going, however, I am optimistic that the results will show growth by the interns in developing their own knowledge about formative assessment and ability to implement effective formative assessment practices. This assumption is based on my reviewing and providing feedback of their lesson plans throughout this year as part of the course requirements. There are many expected implications of this project. First, working on this project has supported my own growth as a teacher educator. Second, these new teachers are likely more prepared to assess their students because of the focus this year on formative assessment and other assessment methods. Third, the activities I implemented are not unique to mathematics, therefore other teacher educators could implement these types of practices in their own methods courses to support more pre-service teachers in developing formative assessment practices. Fourth, the activities and assignments I have developed will likely be an important part of these courses going forward, even when I am no longer teaching them.
Assessing the Impact of Digital Evolution Software on Student Understanding of the Origin of Variation During Evolution

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Mentor: Dr. Louise Mead; IRB# x12-137e/ APP# i040365

Understanding evolution is a common stumbling block for undergraduate students, and as this process is critical for an accurate understanding of biology, an important one. A number of principles underlie evolution by natural selection, including variation, inheritance, and fitness. One concept that remains difficult for many students to grasp relates to the 'origin of variation', which includes the ideas that trait variation is caused by genetic variation, and is caused by mutations that occur randomly.

Because an understanding of evolution requires complex thinking, teaching methods that allow students to interact with the core concepts fundamental to evolution and diminish misconceptions about these underlying principles are highly desirable. Common misconceptions include the ideas that organisms 'want' or 'need' to change in response in the environment, or that mutations are a consequence of selective pressure. Improvements in student understanding of this topic have been observed when using an inquiry-based teaching intervention. Avida-ED is a digital evolution software platform for educational applications that has been shown to help students understand evolutionary processes. Still, the origin of variation principle has remained difficult for students to understand, even with Avida-ED.

Avida-ED was implemented in 6 sections (n=114 students) of an introductory biology lab course, and students received 3 introductory exercises to familiarize themselves with Avida-ED, the last of which provided focus on origin of variation. Students were required to complete a research project within small groups. Project topics for each section varied and were guided by the TA for that section, with the Avida-ED sections using the software to address student-formulated research questions. Student understanding of the origin of variation was evaluated before and after the project portion of the course by asking multiple choice and short answer questions. Results from the Avida-ED inclusive sections were compared to 5 control sections (n=95 students) from the same course. Initially from pre-test data, there was no difference in the proportion of correct answers between groups (p = 0.67). However, there was a high occurrence of misconceptions about origin of variation, gauged by the 45% average correct response rate of the multiple choice questions on the pre-test. This result was supported by a large proportion of vague or incorrect responses by many students in the open-ended questions. Post-test results suggest an improvement in overall student performance on the questions being evaluated, but not an additional effect from using Avida-ED (Pre- vs Post-test p=0.03, Avida-ED vs No Avida-ED p=0.76). Findings suggest that Avida-ED provides an avenue to teach about the origin of variation in evolution, albeit perhaps not superior to other approaches. This indicates that Avida-ED works well within the context of this course as an approach for student research projects. While this study was done in a physical lab course, some courses do not have lab materials and infrastructure. Avida-ED has as an advantage over other approaches that it does not require lab space for students to complete activities, and may be preferable in some courses as a way to provide students with exposure to evolutionary principles in a direct and repeatable experimental manner. This tractability means that Avida-ED has promise for improving the teaching of science to students.
Students that are able to think metacognitively, or think about one’s own thinking process, are able to perform at a higher level in the classroom. Currently, much focus has been placed on how to evaluate student classroom performance but less is known about the development of students’ thinking processes and metacognitive skills. Especially in lab courses, students are often presented with lab protocols in which they can complete the physical tasks of the lab without understanding the process or the implications of their work. In this study, student metacognition was evaluated in an upper level plant physiology lab course at Michigan State University. Qualitative and quantitative data were collected from eight students over the course of the semester during which 5 lab units were completed. The students were asked to complete pre- and post- lab metacognition exercises for each of the labs, which included a self-assessment prediction of their success in the lab on a scale of 1 to 10. The pre- and post-lab metacognition prompts and rubrics were created to evaluate the level of metacognitive thought that students conveyed in response to each prompt. For example, a pre-lab metacognitive prompt asked students to state assumptions that they were making about the upcoming lab. Qualitative data and direct student feedback were used to modify the prompts throughout the course of the study. Rubrics were developed to score the metacognitive level of student responses on a scale from 1-3, but students were given course credit based only on completion.

Qualitative metacognition data was correlated to students’ classroom performance, and the prompts were useful to the instructors and in the students in identifying specific points of confusion and barriers to learning that could be directly addressed in class. Cursory quantitative data indicate a positive correlation with students’ total metacognition scores (pre- and post-lab) and course grades. However, a slight negative correlation was suggested between students’ self-assessment prediction scores and course grades. These data may indicate that while students that display strong metacognitive skills perform well in the course, they may be more aware of what they do not know and thus assess themselves lower. This study did not find a change in students’ metacognitive scores over time, which is likely due to the low number of students in the course and the lack of intervention to discuss the prompt responses. Future work will be done with a larger class of lower level students and will use more direct interventions and discussions of strong vs. weak metacognitive responses. In total, this work provided useful feedback to the instructors on the thought processes of the students and provided the students with an opportunity for self-reflection and evaluation.
Impact of a Flipped Laboratory Structure on Student Performance in a Construction Materials Testing Laboratory for Civil Engineers

Wouter Brink, Department of Civil and Environmental Engineering Department

Mentor: Dr. Neeraj Buch, IRB #: X15-146E

The Civil Engineering field requires students to make connections between theory and practice. The scale and magnitude of most Civil Engineering projects are too large to accurately replicate in a classroom or laboratory setting. In order for students to make this connection, laboratory courses can focus on real world applications and attempt to bridge the gap between theory and practice.

Traditionally, Civil Engineering labs follow a systematic teaching style where the teaching assistant or professor briefly discusses the details of the experiment and then letting the students follow and perform the testing procedure. Using this method, students may not make the connection to the practical importance which can reduce the significance of the experiment. This issue was addressed by restructuring the laboratory section of CE337 – Civil Engineering Materials I. The new format focused on a goal oriented flipped classroom design. The students were required to design a Portland cement concrete mixture with a compressive strength of 5,600 psi. The students were expected to research the various material tests on their own and consult with the lab TA to discuss the necessary procedures to meet the goal.

This research studies if a flipped laboratory structure improve student grades and laboratory confidence compared to the conventional laboratory teaching methods. The objectives were to study the 1) effectiveness of using a flipped classroom approach for a materials testing laboratory, 2) student confidence in performing laboratory experiments before and after the flipped laboratory, and 3) if the flipped classroom has an impact on student grades compared to the traditional methods. These objectives were evaluated by comparing student laboratory grades from previous semesters and performing a survey to determine prior laboratory experience and individual confidence to perform the laboratory experiments.

The survey results indicate that the majority of the students already took the other Civil Engineering courses which also have laboratory sections. Very few students have had any experience with a goal oriented laboratory because the other courses use the traditional lab teaching method. The survey results also showed that the majority of the students (71%) felt confident or very confident in their abilities to perform the experiments outside of an academic setting. The majority of the students indicated that each group member was held accountable and that the practical implications of the laboratory experiments were made clear. The exit survey results indicate that students prefer the goal oriented teaching method but also highlighted that some improvement is necessary.

These results are preliminary and this research should be continued in future semesters to truly study the impact of the flipped laboratory structure. Additionally, if this intervention shows a difference between the two teaching methods, then it can be expanded into other Civil Engineering courses.
Assessing Natural History Museum Exhibit Panels: How does panel design impact college learner knowledge and engagement?

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Mentor: Dr. Julie Libarkin; IRB #X11-138

Museums are integral parts of college campuses, present in 13 of the 14 Big Ten schools and on many campuses across the country. Museums hold content applicable to many courses, yet are not fully used by faculty and students. Museum visits are usually incorporated into a syllabus as self-guided student trips. Thus, the guidance provided by the design and content of museum panels associated with objects and visuals are critical to the college learner’s self-guided experience. Traditional museum evaluations effectively assess where learners spend time within a museum exhibit, but cannot assess how learners interact visually with the panels. This work evaluates the effectiveness of the design of 3 kinds of museum panels, text-based, graphic-based, and model-based, by monitoring eye movements of college learners as they interact with each panel. Panels were chosen to evaluate how learners interacted with text-heavy panels, panels that were heavily dominated by a concept model, and with panels that attempted to integrate graphics with text in the hope of informing best practices in museum panel design, and included content on glaciation and the carbon cycle.

Learners spent an average of 2.5 min. interacting with all 3 panels, although learners presented with the text-based panel first spent an average of 40 more sec. interacting with all panels, and between 1-20 sec. more on model - and graphic - based panels, respectively. Overall, learners devoted about 28 sec. to the model-based panel, 49 sec. to the graphic-based panel, and 1 min. and 42 sec. were devoted to the text-based panel. Learner gaze patterns were compared to ideal viewing patterns provided by the panel designer. Individuals generally interacted with text-based and model-based panels in a manner consistent with ideal viewing patterns, while interaction with the graphic-based panel was less consistent with the intentions of the panel designer. Eye fixations were clustered in areas of interest reflective of content areas (e.g. graphs, text) and areas with visual appeal but no content contributions (detractors). Learners spent the largest proportion of their time on large font size content text (35-50% of their fixations) regardless of panel design type. Between 5-15% of learner fixations were focused on visual detractors. The graphic-based panel, in addition to being engaged with inconsistent with its intended design, showed the highest percentage of time spent on detractors, suggesting that aspects of the graphic–supported panel design, content, or a combination of both were distracting to learners.

Learner knowledge gains were measured using validated questions pre- and post- interaction with the panels and showed content knowledge gains in 7 of 9 questions and an average score change from 63% on the pre-test to 70% on the post. No increases were significant, but learners experienced larger content knowledge gains on the carbon cycle than on glaciation/CO2 relationships. Surprisingly, learners only answered 1 of 4 questions relevant to glaciation more accurately after interacting with panels despite spending more time on the glacier panel than on the other panels combined. This suggests that the traditional method of museum evaluation may not characterize learner engagement with museum content. Museum exhibit designers may consider frontloading text-heavy panels when installing exhibits and limiting supplemental text on graphic-heavy panels to avoid dividing learners’ attentions.
Examining Student Conceptions of the Nitrogen Cycle
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Mentor: Dr. Stephen Thomas; IRB x14-1283e

Nitrogen is arguably one of the most important elements on Earth, but education about this element presents distinct challenges. As an essential component in living cells, the fertilizers that sustain food production, and the atmosphere, nitrogen provides an opportunity to learn key concepts in ecology and environmental science. These concepts fit in a broader group of core concepts and skills in biology, such as systems, pathways and transformations of matter, and quantitative reasoning. Despite their importance for life on Earth and its connection to important topics within biology, elemental cycles (e.g., nitrogen, carbon, water) can be difficult and often discouraging for undergraduate students to learn.

The objectives of this study were (1) Describe the conceptual understanding, knowledge application, and misconceptions of the nitrogen cycle among undergraduate biology students, (2) Determine differences in nitrogen cycle knowledge among introductory, intermediate, and advanced students, and (3) Examine results in the context of current teaching practices and future improved instructional strategies.

These objectives were accomplished through a series of written surveys and interviews that assessed student knowledge about various aspects of the nitrogen cycle. Surveys were administered to 100-, 300-, and 400-level students (n=222) in biological science courses at Michigan State University. Interviews were conducted with a small subset of participants from each course (n=7). Interviewees were asked to discuss topics related to the nitrogen cycle and their attitudes about it, draw a diagram of the nitrogen cycle, and interpret a textbook diagram of the nitrogen cycle.

Total scores on the written survey were significantly higher among intermediate and advanced students than introductory students (ANOVA, p < 0.001), but total score did not differ among intermediate and advanced students. Statements of misconceptions related to nitrogen cycling processes decreased with course progression, from 27% among introductory students to 3% and 8% in intermediate and advanced students, respectively. Despite a general improvement in nitrogen cycle knowledge as students progressed in their undergraduate degree, there was poor performance among all three groups for several topics, including quantitative reasoning and transformation mechanisms. These results indicate that limited coverage of the nitrogen cycle and lack of integration of the nitrogen cycle with other concepts in courses can hinder students' ability to apply this knowledge in new contexts. This was especially apparent in interview sessions, wherein participants expressed difficulty in remembering chemical transformations, microbial processes, and connections between the nitrogen cycle and other aspects of ecology. Improvements in instructional strategies for nitrogen cycling should thus (a) emphasize integration of concepts over memorization, (b) build on previous student knowledge rather than teaching concepts from the ground up, and (c) utilize diagrams that clearly and completely describe N cycle processes.
Assessment of Cooperative Learning to Enhance Cultural Sensitivity Knowledge and Skills

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Mentor: Lorraine Weatherspoon, PhD, RD; IRB# x14-1351e

Cultural sensitivity in health care is defined as the ability to include cultural competence skills and knowledge in the delivery of healthcare to enhance patient comfort, respect, and trust in the healthcare process. Cooperative learning can be a unique way to practice cultural sensitivity skills by engaging students in conversations where they can express their cultural competence knowledge. Cooperative learning assignments have several key elements, but two of these: positive interdependence and interpersonal and small group social skills, are important for the practice of cultural sensitivity skills. By designing cooperative learning assignments centered on cultural sensitivity topics, pre-professional undergraduate students have an opportunity to practice and enhance their cultural sensitivity skills in a classroom setting. The purpose of this study was to determine how cooperative learning in an undergraduate nutrition and dietetics course enhances application of cultural sensitivity skills for nutrition-related concepts. The objective was to examine how a cooperative learning assignment on religion, one of the topics in a cultural foods course for nutrition and dietetics majors, can enhance understanding.

An extra credit pre-assignment, in-class activity and in-class discussion of the activity were used. Other topics taught during this module of the course included history of food and eating of early civilization and new world influences and technological advances in food. Institutional review board approval was obtained to complete the study. Out of 105 students enrolled in the class, 86 provided informed consent. Data collected and included for analysis were responses to pre-assignment, in-class assignment, and the exam for the first module. Additionally, demographic information from the registrar and responses to anonymous minute papers on this exam were collected. There were no significant changes in scores on selected questions from the pre-assignment (pre-test) to questions on the exam (post-test). However, students earned higher percentage of points (93%) on the religion questions on the exam, compared to the other four topics (72-91%). Qualitative analysis of the minute papers indicates students more frequently included the topic religion compared to the other topics when asked what are the three most useful things learned from this exam. In addition, there was more variety in religions discussed in the exam by those who completed the pre-assignment, average of 2.6 compared to those who did not, average of 1.9.

Although students earned more points in the religion topic compared to the other four topics in the first exam, it could be due to greater interest in the topic as indicated by the minute papers. While the findings of this study were not significant, responses on the exam indicate that students were able to explain health-risks and health benefits of more than one religion other than their own. Practicing cultural sensitivity skills during the group and class discussion could have enhanced their interest in the topic and their ability to discuss health risks and benefits of different religions. In STEM education, providing students with structured opportunities to learn from each other can enhance their skills and knowledge of such concepts.
Helping Students Critique Their Experimental Results
Markus Downey, Department of Chemical Engineering

Mentors: Dr. Maddalena Fanelli & Dr. Dennis Miller; IRB Exempt # x15-115e

Students not considering the validity of the data they collect or the answers they calculate is an issue that spans all academic fields in sciences and engineering. Once outside the structure of classroom learning, self-assessment of experimental results is critical. The topic of extrinsically motivating students to consider the validity of the data they collect or answers they calculate was investigated in this study.

Student in a junior/senior level chemical engineering laboratory class were extrinsically motivated to make sense of the answers they generated during the course of 5 experiments conducted throughout the semester. The extrinsic motivation took the form of two questionnaires, one during the pre-experiment phase, the other during work on the final report. In the pre-experiment questionnaire, the student teams were asked to relate a quantity they would be measuring or calculating in the experiment to something they have a feel for (pressure in a car tire, power used by a light bulb) and how that would help them judge the validity of the collected data. For the final report questionnaire, the student teams were asked to judge how confident they were that their data was correct (Likert scale) and justify how they came to this answer. Grading rubrics were used to judge the quality of the answers for both questionnaires. An improvement of the grading rubric score, indicating higher quality answers, and an improvement of the lab report scores was expected as an indicator of successful motivation.

The results of the study reflect the trends reported in the literature that extrinsic motivation does not have a positive impact on student behavior. Response rates for the final report surveys were low (50-60%) even though points were awarded for simply submitting the surveys. Surprisingly, there was no noticeable positive development of the total lab report scores as the semester progressed. There also does not appear to be a noticeable improved the grading rubric scores (quality of the answers) to the questionnaires for both pre-lab and final report. Trends in the individual survey responses have not yet been establish. One observed trend in the Likert scores of how confident the teams are in the validity of their data, is the percentage of the team responding in the “Somewhat Sure” category increases as the semester progresses. While this could imply an improved feel for data quality, the actual scores pertaining to data and experimental quality do not follow this trend, implying that the increase in the data confidence score is presumably more based on student perception.

The implication of this study is that extrinsic motivation with repeated simple questionnaires is not sufficient to improve students feel for the validity of their data. More success might be expected with the addition of feedback and training after each experiment throughout the semester. These interventions might have to be applied over multiple classes and semesters. Time and resource constraints will have to be taken into consideration when applying additional training.
Online homework is playing an increasingly prominent role in college calculus classes across the country. Although there are benefits of online homework—instant feedback to students, decreased resource allocation by departments, and personalized assignments—there is a lack of research describing how the shift to online homework influences student learning. The goal of my research is to understand how students experience online homework based on their (a) perceptions about its usefulness, (b) related study habits, and (c) utilize resources to complete online homework. Using an online survey, I gathered data from 154 (23%) Calculus I students about their experiences related the aforementioned topics.

The data indicates that students value online homework as a learning tool, but think online homework assignments are too long and indicate that they would appreciate written homework in addition to online homework. Students estimated, on average, that they spend about 5 hours per week on online homework and do so mostly alone, making little use of study groups, office hours, or tutoring available at the Math Learning Center. The resources that were reported to be most frequently used are class notes, “similar examples” within the online homework system, and online calculators, while YouTube videos, informational websites, and classmates are used less frequently. The textbook, the Math Learning Center, office hours, private tutors, and online help forums are all used infrequently.

Although this research is exploratory, it can inform instructors’ perceptions about calculus students. First, it appears that students may, in fact, desire more homework, or at least an adjustment in the nature of the homework, so that the homework better fits their needs and supports their learning. Second, the data provides information about the types of resources that students employ, which can help instructors support students with resources that align with how students consume information. Third, the data raises questions about the unintended consequences of the shift to online homework, namely that students mostly work alone while completing online homework.
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