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SoTL Grant Application Form

(2015-2016)

To be considered for funding, your research proposal must align with the following definition of the Scholarship of Teaching and Learning, SoTL, endorsed by the University Faculty Council in January of 2014:
"*The rigorous investigation of student learning, with the purpose of developing novel teaching methodologies and practices that can lead to the measurable enhancement of student learning. The results of the investigation are made public through quality scholarly outlets and widely-accepted conferences and general or discipline-specific journals.*"

Proposals are due to the Office for Teaching, Learning, and Assessment by **Thursday, September 10th, 2015** and should be submitted online. Award recipients will be notified by Tuesday October 6th, 2015. Funded recipients will need to submit a final report for the grant project to TLA by September 1st, 2016.

I. Basic Information

Title of Project: Exploring student use of whiteboards using classroom video

Investigator(s) Information

Principal Investigator:

Name: Mary Bridget Kustusch
College: College of Science and Health
Department: Physics
Phone Number: 773-325-0389
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Other Investigators (Co-Pi):

Name	College	Department
Susan Fischer	College of Science and Health	Physics

For each investigator, please include an abbreviated CV using the SoTL grant CV template.

Will your project involve human subjects? ■ Yes ☐ No
If Yes, you must include evidence of IRB approval or exemption, or of having applied for IRB approval or exemption. Please note that before any granted funding can be made available, you will be required to provide evidence of IRB approval or exemption.

IRB Research Protocol # MK030714PHY-C1 approved through March 19, 2016 (letter attached)

Requested Funds

Amount Requested (up to $2,500): $2500

II. Project Abstract (250 words or less)

As a part of an ongoing shift toward more student-centered classrooms, the Physics Department has transitioned the majority of its courses to a studio-style environment where students collaborate in small groups on a variety of activities. This type of environment provides numerous opportunities for observing student behavior and learning, including interactions with peers, with instructors, and with technology. One of the most common tools for promoting discussion in this environment is the use of group-size whiteboards. While used extensively and enthusiastically by many, there has been little research on the effectiveness of this technology or on best practices for developing whiteboard activities. As a part of larger project exploring student understanding and interactions, we have amassed an extensive set of data, including almost 200 hours of class classroom video in this environment. We propose to produce a catalog of this video data and use this catalog to explore when and how groups use whiteboards to engage in activities and how this use correspond to different types of interaction and discourse. Results will be shared internally, with instructors of relevant courses and with the DePaul community through the Teaching and Learning Conference, and externally, at a national conference and peer-reviewed conference proceedings. In addition, the catalog created for this project will facilitate several other lines of inquiry using the same extensive data set.

III. Project Description (1000 words or less)

Project Overview (Purpose, Theoretical Framework, and Research Methodology)

It is widely accepted that actively engaging students in the classroom enhances learning, as well as attitudes about science, when compared to the traditional lecture approach [Beichner, et al; Docktor and Mestre; Hake; Madsen, et al]. In light of this research, the Physics Department has been transitioning to more student-centered classes, where the majority of class time is spent with the students collaborating in small groups on activities involving problem-solving, computer simulations, and/or hands-on experiments. As a result of renovations in the summer of 2014, we now have two studio-style classrooms with round tables to facilitate small group interactions [Beichner, et al; Gaffney, et al] and the majority of physics courses are now taught in these rooms. This environment provides numerous opportunities for observing student behavior and learning, including interactions with peers, with instructors, and with technology.

In Spring 2014, we (Drs. Kustusch and Fischer) began a long-term project designed to
- assess current levels of student understanding of specific physics content and skills;
- identify sources of student difficulty with those content and skills;
- assess how and to what extent current classroom activities elicit and address student difficulties;
- redesign classroom activities to better facilitate student learning; and
- document how these activities are/can be enacted in this type of environment.

Based on our overlapping background and interest in embodied cognition and student understanding of vector algebra [Kontra, et al; Kustusch], we chose to focus on PHY 152, the third quarter of the introductory physics sequence, covering electromagnetism and some modern physics. In addition, this algebra-based sequence is comprised primarily of life science majors and represents a large and relatively under-studied population. We have collected approximately 188 hours of classroom video, as well as additional student work (See Table 1).

Quarter	Sections	Days	Camera view	Hours	Additional Data
Spring 2014	1	6	Whole classroom	≈ 8	Online homework and reading assignments
Spring 2015	3	23	Whole classroom	≈ 90	Online homework and reading assignments Group writing assignments Quizzes and Exams
			Table/Group	≈ 90	

Table 1. Data collected as a part of this project

We have already presented two preliminary looks at this data. At the 2014 American Association of Physics Teachers Summer Meeting, we presented short clips and images from the 2014 classroom video to demonstrate a sequence of embodied activities developed to help students better grasp the spatial nature of electric and magnetic fields [Kustusch and Fischer]. This summer, Jaime Bryant, an undergraduate who helped to collect the 2015 data, conducted a preliminary analysis on written quiz responses exploring the extent to which students struggle to appropriately account for the position of the observation location relative to the source of the field. This research was presented as a poster at the 2015 Physics Education Research Conference and submitted as a conference proceedings paper for peer review [Bryant, et al].

Over the next several years, we plan to use these data to pursue several lines of inquiry. As a first step, we are requesting funds for undergraduate researcher(s) to catalog the video data and to identify appropriate episodes that would be of interest for deeper analysis. In addition, the undergraduate researcher(s) will work with Drs. Kustusch and Fischer to provide recommendations for additional data to be collected in Spring 2016 and to analyze the data to address the following research question:

> **When and how do groups use whiteboards to engage in various types of activities and how does this use correspond to different types of interaction and discourse?**

This research question arises from the fact that group-size (2' x 3') dry-erase whiteboards are a common and inexpensive technology used in many studio-style environments to promote discussion [Wells, et al]. Many physics and math teachers have informally praised the use of whiteboards at education levels and offered advice on implementation [MacIsaac; Emeny]. However, very little research has been done to assess the effectiveness of whiteboard use or to provide guidelines for developing whiteboard activities.

The most relevant study is Colleen Megowan-Romanowicz's Ph.D. dissertation [Megowan], which includes a qualitative examination of student learning in physics courses based on the Modeling curriculum [Wells]. These classes relied heavily on small group work and often employed whiteboards. Through observations, Megowan identified several roles that students typically take on in group discussions, and common ways that groups used the whiteboards. For instance, when student whiteboards included primarily equations and computational problem-solving, there was little dialogue among the group members, but when student work on the whiteboards was built around a diagram or graph, the level of discussion increased and became more meaningful.

Based on these reported observations and on our own teaching experiences, we propose to use our video data to explore how our classes and students are currently using these whiteboards. We will draw on methods from interaction analysis [Jordan and Henderson] to address our research question, focusing on:

- identifying the types of artifacts students choose to write (e.g., drawing graphs, representations of physical situations, computational problem-solving, etc.);
- characterizing student discourse during whiteboard use (e.g., mutual exchange of ideas, little dialogue, one group member "lecturing" the others, etc.); and
- comparing student behavior when the activity explicitly prompts whiteboard use to when the use of the whiteboard is more spontaneous.

By addressing these questions, we hope to better understand the role that whiteboards play in the classroom as well as provide recommendations for best practice.

<u>Impact and Dissemination of Results</u>

We plan to discuss the results of our research with faculty teaching PHY 152 in Spring 2016, to work with them to revise current activities, and when appropriate, to develop new activities in the light of our results. Since the use of whiteboards extends beyond physics, we expect to present results at the 2016 DePaul Teaching & Learning conference, submit a paper for the 2016 Physics Education Research Conference Proceedings, and explore appropriate peer-reviewed venues that will reach a broader audience. In addition, our plan is for this catalog to provide a useful means of identifying appropriate data for several undergraduate and graduate research projects and publications over the next few years.

IV. Project Plan and Timeline

Fall Quarter 2015:

- Submit IRB amendment to add undergraduate researchers (if necessary)
- Undergraduate researcher catalogues video data and identifies episodes of interest*

Winter Break 2015:

- Undergraduate researcher catalogues video data and identifies episodes of interest*

Winter Quarter 2016:

- Undergraduate researcher finishes catalog of video data and identifies episodes of interest*
- Preliminary analysis of relevant episodes and identification of additional data needed
- Submit continuing review for IRB and amendment for new data (if necessary)

Spring Quarter 2016:

- Undergraduate researcher(s) gather additional data and catalogue it during the term (We plan to submit a URAP proposal to fund this portion of the project)
- Present research at DePaul Teaching & Learning Conference (May 20, 2016)
- Draft paper for Physics Education Research Conference Proceedings (abstracts due mid-June)

Summer 2016:

- Present research at Physics Education Research Conference
- Submit paper to Physics Education Research Conference Proceedings
- Explore options for peer-reviewed venue with broader audience

* indicates how grant money will be spent during each term.

V. Budget

We are seeking funding for 1-2 undergraduate researchers to catalog existing video data, work with the PIs to conduct preliminary analysis, and identify appropriate additional data to collect in Spring 2016.

We estimate the catalog of all of the existing video data will take approximately 188 hours, plus an additional 20 hour of analysis. At a student pay rate of $12/hour, this brings us to $2496. The expectation is the student will work 10 hours/week during the quarter and 15-20 hours/week during winter break.

Initial offers will be extended to the two undergraduates (Jaime Bryant and Rita Dawod) who collected the data in Spring 2015, since they have familiarity with the data and IRB approval for the project.

VI. Selected References

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