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Grant Title: Solution-Oriented, Student-Initiated, Team-Based, Computationally-Enriched (SOLSTICE) Training

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Website: <https://sites.tufts.edu/naumovalabs/solstice-info/>

GRANT OVERVIEW

Innovative approaches to graduate STEM training are needed to prepare students for the workforce both in and out of academia and addressing the rapidly changing demands of data-intensive sciences. To this end, an interdisciplinary faculty team will implement, evaluate, and disseminate a transformative learning approach to graduate education by involving students in *solution-oriented, student-initiated, computationally-enriched (SOLSTICE)* training. The *SOLSTICE* approach aims to teach graduate students to solve complex problems, think critically, and effectively communicate across inter-generational, trans-disciplinary research teams. Using a data-intensive, project-based learning approach, students work collaboratively to design, evaluate, and disseminate research in team environments.

RESEARCH QUESTIONS

1. To what extent does the *SOLSTICE* approach provide opportunities for students to achieve 21st-century data intensive knowledge, skills, and attitudes?
2. Are there variations in students' achievement over time, across different courses that implement the *SOLSTICE* approach, and across different STEM disciplines?

OUR APPROACH

We will collect and analyze ~570 pre/post assessments from ~270 participants, and monitor students' performance at least 6 months after completing a semester-long course. We will compile educational resources to guide students in this training process, to train faculty in the *SOLSTICE* approach, and to disseminate this approach to STEM fields beyond nutrition science and engineering. The *SOLSTICE* approach applies three novel methodologies to graduate education:

1. **3D Role Play**, in which each student plays the roles of Team Lead, Collaborator, and Reviewer on three interdisciplinary teams to develop, execute and communicate a research project;
2. **Feedback on Feedback**, which provides students with experience in giving and receiving effective critiques with their peers; and
3. **Data Analysis Roadmap**, which provides knowledge building and examples of key components of effective data analysis, plans, and other resources for the effective communication of results.

INTELLECTUAL MERIT

While project-based teaching has been shown to be effective, it is difficult to implement and scale. This project provides guidance in selecting topics and data for secondary analysis, structures teamwork experiences with clearly defined roles and responsibilities, and guides students in effective communication and responsible conduct of research. The evaluation of this approach will be drawn from students' learning and action, including behavior, practice, decision making, adapted policies and social action. *SOLSTICE* will provide the foundation for transformative graduate education across STEM fields.

STUDENT INCENTIVE TO PARTICIPATE IN SOLSTICE

Previous participants enrolling in this grant have noted the following benefits:

1. **Improvement in quantitative skills and reasoning.** This included greater experience performing research projects, conducting and understanding data analyses, completing data-related projects, and refining technical programming skills.
2. **Resources are available for student reuse.** We have created a diversity of auditory and visual resources to assist your personal learning process in statistics and data sciences. These resources assist in the iterative process of independent data analysis, collaborative feedback from peers, and faculty guidance allows for maximum retention.
3. **Enrollment is easy!** Students are just required to complete a few short surveys and multiple-choice assessments to evaluate their knowledge, skills, and attitude at the beginning and end of your course. Many courses also offer extra credit when choosing to enroll in the study!

FACULTY INCENTIVE TO PARTICIPATE IN SOLSTICE

1. **Providing more-detailed information on faculty students' knowledge, skills, and attitudes towards data intensive disciplines.** The pre- and post-semester survey we conduct provides greater insight on the knowledge, skills, and attitudes of students taking your course. This can assist to improve course preparation between semesters.
2. **Supporting collaboration across teachers of data-intensive courses.** All faculty will take part in a workshop to learn about the *SOLSTICE* approach and ways for integrating this approach into their course. This collaboration can help coordinate course topics, aims, and materials within school departments and across schools to maximize student learning.
3. **Reduce faculty burden to collect information on students' participation and performance.** The Research Coordinator working on the *SOLSTICE* team will administer and analyze student surveys and assessments for those that enroll.

HOW TO GET INVOLVED

1. **Faculty members choose to enroll their course into the study**, which is completed through email correspondence with the Research Coordinator (Ryan.Simpson@tufts.edu). Once consenting, the faculty member's course information will be posted on the grant website.
2. **Students participate in the study by submitting a [consent form](#)**, which allows us to use student survey responses, assessment answers, and class grades. All information is private – responses, answers, and grades will only be reviewed by the *SOLSTICE* research team. The consent form can be signed electronically and then emailed to Spring_zn441dtfkzk6nten@u.box.com
3. **Students complete in a [short survey](#) at the beginning and end of the semester** that is used to establish baseline knowledge, skills, and attitudes in data science. This will not be shared with instructors or classmates and has no effect on student's grades! The entry survey should take no more than 15 minutes to complete.
4. **Complete a [short assessment](#)**, which includes 15 multiple choice questions asking on topics and questions related to the grant aims and objectives. This will also have no effect on student's course grade and will only be reviewed by the *SOLSTICE* research team! The assessment can be completed electronically by highlighting answers and then emailed to Spring_igmmcan1pawwvlz2@u.box.com

QUESTIONS?

The broader impacts of the *SOLSTICE* approach on STEM graduate education focus specifically on those fields that are data-intensive. We are currently seeking graduate professors who have existing project-based curricula or are willing to become involved in such a project. If considering or interested to learn more information, please contact Ryan.Simpson@tufts.edu and Elena.Naumova@tufts.edu.