Effects of student autonomy in a course-based undergraduate research course on student perceptions of laboratory teaching and student outcomes

Short study title: Effects of Student Autonomy

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Sponsor: National Science Foundation

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External (non-Emory) Collaborators: Dr. Lawrence Blumer, Morehouse College, Department of Biology. Will be reviewed by Morehouse College IRB.

Background and significance:

Although studies suggest that course-based undergraduate research experiences (CUREs) result in greater student learning gains compared to traditional “cookbook” laboratory courses (Beck et al. 2014, Corwin et al. 2015a), the evidence is considered to be “limited” (NRC 2012), as most studies focus on single courses at single institutions. To date, studies on inquiry-based learning in laboratory courses (including CUREs) have focused on broad comparisons of inquiry versus “cookbook” and not on how inquiry leads to improved student outcomes (Corwin et al. 2015a) and what aspects of CUREs lead to improved student outcomes. For a rigorous test of the role that student autonomy plays in the outcomes for students, it is necessary for students to experience the same CURE (thereby holding discovery, relevance, collaboration and iteration relatively constant) implemented with different levels of student autonomy. Furthermore, the sample should include students in different courses, at different levels from a range of institutions. Therefore, the overall goal of this project is to assess the importance of student autonomy in using scientific practices (proposing research questions and designing experimental methods) in a discovery CURE across diverse institutions. Dissemination of the results of this study through presentation and publications will inform the future development of CUREs.

Goals/Aims: The goal of this project is to assess the importance of student autonomy in using scientific practices (proposing research questions and designing experimental methods) in a discovery CURE across diverse institutions

Study Design (include applicable items):

This study is co-directed by Dr. Christopher Beck in the Department of Biology at Emory University and Dr. Lawrence Blumer in the Department of Biology at Morehouse College. The study is funded by the National Science Foundation to examine the outcomes of a new course-based research curriculum. The surveys will be implemented by Dr. Beck. Dr. Beck and Dr. Blumer will be involved in data analysis and presentation and publication of the results.

The bean beetle microbiome curriculum will be implemented in undergraduate laboratory courses at colleges and universities across the US. Faculty teaching the curriculum will have been trained in the curriculum at professional developmental workshops at Emory. Students in these courses will be asked to participate in online surveys at the beginning and the end of the semester. Participants for the study will be recruited by their laboratory instructors at the beginning of their courses that implement the bean beetle microbiome curriculum. Recruitment will be done in person and online through course management software. To recruit participants, students who complete the survey will be receive extra credit. If students decide not to take part, they can instead upload a short narrative (150-250 words) on the role of undergraduates in the scientific research community to receive the extra credit. Approximately 1500 students in total will be enrolled in the study. All participants will be over the age of 18. The online surveys will be administered through Qualtrics survey software through Emory College.

For the pre-semester survey, students will be asked questions from the PITS survey (Hanauer et. al. 2016) and the expanded experimental design ability test (Brownell et al. 2014). In addition, they will be asked about the science courses that they have taken, their gender, race/ethnicity, and status as a first-generation university student. They will be asked to provide the last 6 digits of your cell phone number so that your responses from the two surveys can be link. For the post-semester survey, students will be asked questions from the PITS survey (Hanauer et. al. 2016) and the expanded experimental design ability test (Brownell et al. 2014). In addition, they will be asked questions from the instructional practices survey (Beck and Blumer 2016) and the laboratory course activities survey (Corwin et al. 2015b). Each survey will take approximately 20 minutes to complete.

Informed consent will be presented online at the beginning of each survey. Participants will be asked to consent to participation at the beginning of the survey by answering a multiple choice question that they are willing to participate in the study. We will request a waiver of signature because the responses are anonymous and the risks of the study are minimal.

## The risks and discomforts associated with participation in this study are minimal. There is some risk of loss of anonymity based on demographic factors. There are potential discomforts associated with recalling negative experiences in laboratory courses.

This study is not designed to benefit participants directly. This study is designed to learn more about the effects of student autonomy in a course-based undergraduate research course on student perceptions of laboratory teaching and student outcomes. The study results may be used to help others in the future in laboratory course design.

Participants will not be compensated.

Data will be stored on password-protected network drives. All data will be anonymous. Pre and Post tests will be linked via 6-digit identifiers.

Student responses on each implementation of the survey will be matched with their subsequent responses using the individual identifier (last 6 digits of their phone number). Responses for students who only complete one of the surveys will be dropped from the analysis. We will then examine changes in each student outcome over time and the potential impact of demographic factors and instructional practices on changes in constructs over time, using mixed models with time and lab section as a random effects to control for repeated surveying of the same students and non-independence of students in the same course.

All members of the study team will have completed CITI certification or similar training.

To insure confidentiality, all responses to the survey will be anonymous and all results of the study will be reported in aggregate.

References

Beck and Blumer. 2016. CBE Life Sci Educ 15:ar52.

Beck et al. 2014. CBE-Life Sciences Education 13:444-452.

Brownell et al. 2014. Bioscience 64:125–137.

Corwin et al. 2015a. CBE-Life Sciences Education 14:1-13.

Corwin et al. 2015b. CBE Life Sci Educ 14:ar37

Hanauer et al. 2016. CBE-Life Sciences Education15:ar54.

National Research Council (NRC). 2012. *Discipline-based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering*. S.R. Singer, N.R. Nielsen, and H.A. Schweingruber, Editors. Committee on the Status, Contributions, and Future Directions of Discipline-Based Education Research. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.