2018 SOCIETY FOR THE IMPROVEMENT OF PSYCHOLOGICAL SCIENCE

Hackathon: Teaching replicable and reproducible science

Replication in the Classroom - A Case Study

Introduction

This case study aims to serve as a component of a lesson focused on teaching replicable and reproducible science for students at all levels, from undergraduate students in introductory classes to graduate students. As such, it contains varied elements that can be attended to by different populations, and of course it can be modified to meet your own students' needs (such as changing the main protagonist to an undergraduate thesis writer, removing or adding details, or having students analyze the relevant data instead of presenting the statistics). It is designed to be amenable to teaching in a discussion or lecture based class. While this case has aspects that may seem familiar to recent conversations in psychology, it is very deliberately not based on any single event or person.

Hackathon Goals

Your group's charge is to develop teaching materials to accompany the case for a specific audience (e.g., students in undergraduate research methods, first-year graduate students) with specific learning goals. These teaching materials should be self-contained to the extent that other instructors, upon receiving the case materials and your teaching notes, could implement the case in their classrooms. They can include answers to the prompts or other materials, such as Powerpoint slides.

1. **Your group should make an electronic copy of this document and work from that file (or create a separate document or documents that has/ have the relevant teaching materials).**

2. **Name the relevant files as follows: CaseStudy_Population_Description (e.g., if you are creating teaching notes to use the case in an undergraduate statistics course you could write CaseStudy_Undergradstats_Teaching notes).**

3. **At the end of the hack add the relevant document to the "Completed Teaching Materials" component on the hack OSF page.**

Case Study

Liliana Mayes is a third-year doctoral student in developmental psychology. She has a strong working relationship with her advisor, Dr. Arden Blackburn (who is a full tenured professor) and works on a secondary project with Dr. Garnet Hobson (an untenured faculty member in his fifth year on the faculty, who is also on her master's and dissertation committees). Liliana completed her master's thesis last year.

Her thesis consists of two studies. The first study tested the hypothesis that five and six year old children show better understanding of scientific theories after engaging in a hands-on activity while learning the concept. Seventy five- and six-year old children participated at a local science museum. Children were randomly assigned to learn about the food chain through a video and lecture from a college-aged docent and then draw a picture of sharks eating (control condition), or to learn about the food chain through the same video and lecture plus an activity where they reconstructed the food chain. The dependent variable was a series of 10 questions that children were asked individually by an undergraduate research assistant who was blind to condition. Data from 16 children were not used in the study because in the experimenter's assessment, they didn't understand the task or were goofing off during the lecture, video, or activity. Data from 54 children, equally distributed across conditions, remained. Four other undergraduates who were blind to condition and the study's purpose coded children's answers on a scale from 0 (not at all correct) to 10 (perfectly correct); these scores were averaged to create a single score per subject. An independent samples t-test showed that children in the active learning group ($M = 6.37$, $SD = 0.91$) outperformed children in the control condition ($M = 5.81$, $SD = 1.03$), $t\,(52) = 2.10$, $p = .04$.

The second study was a laboratory-based replication of the first study that was preregistered on the Open Science Framework (OSF). One hundred five- and six-year old children came to Dr. Blackburn's Cognitive Development Lab and participated in the study, which recreated the museum experience. The results were similar to the first study - children who had the hands-on activity showed greater conceptual understanding ($M = 5.56$, $SD = 0.74$) than those in the control condition ($M = 5.23$, SD = 0.87), t (98) = 2.05, p = .04. [1]

Liliana presented the work at a conference and it received positive attention in the media and on social media. She is close to finishing a manuscript for publication. In the meantime, a separate research group conducted a replication of her study in their lab and did not find an effect of condition: t (498) = 1.29, p = .20.[2] They have contacted Liliana and described their results, and she has shared their news with Drs. Blackburn and Hobson. She is unsure about what to do now. Her advisor, Dr. Blackburn is encouraging her to disseminate the research as a publication as quickly as possible. Dr. Hobson is less sure what she should do, as he thinks that the external replication with a larger sample undermines the validity of her results. Both faculty members are collaborating on the research and would be authors on any resulting publications.

You are a fifth year graduate student who is friendly with Liliana but uninvolved in her research program. She describes her situation to you and asks for your advice – should she follow her advisor's recommendation and publish the paper as soon as possible, or should she heed Dr. Hobson's caution? If she does not choose to publish the research, what should her next steps be?

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[1] Data for the museum study and lab study are available on the OSF, named mayes_data_study1.csv and mayes_data_study2.csv, respectively. Each file is comma-delimited and contains three variables: Subject (a unique subject number), Condition (0=Control; 1= Active Learning Intervention), and Score (score on the assessment).

[2] These data are also available on the OSF as mayes_data_replicaiton.csv, with the same variables as above.

Creating the Teaching Materials

This framework is based on Herreid, C. F. (2000). And all that jazz: An essay extolling the virtues of writing case teaching notes. *Journal of College Science Teaching*, *29*(4), 225–228.

1. Introduction and Background for the Instructor New to the Case

   This case is designed to be used with students at a variety of levels. Who are you designing the teaching materials for?

   How will the case unfold in the classroom (e.g., lecture, small group discussions, discussion a large group)?

2. What are your learning objectives? "This is the place for specific statements, such as these examples: Students finishing the case will be able to (1) take the data in table 3 and graph it appropriately, (2) write a critical essay about the pros and cons of genetic engineering in crops, (3) write a persuasive letter to their congressional representative about the benefits of cloning, (4) solve the equation p2 + 2pq + q2 = 1 given the following information . . . and so on." (Herreid, pp. 26-27).

   a. Given your student population, what are the key concepts to be illustrated and understood, or questions to be grappled with, as a result of working through the case (e.g., undergraduates in a statistics course might grapple with issues of statistical power, whereas graduate students might think about pressures to publish)? For each issue, what difficulties do you expect that students will encounter/ where will there be disagreement?

   b. What explicit questions or strategies will you use to elicit the major issues in the case?

3. How will you assess the extent to which you have met your learning objectives?