

# Assessing pedagogy for teaching reproducibility and replicability in the geographic sciences

Protocol ID	259
PI	Joseph Holler Signed 08/26/2023 1:15 AM EDT
PI Type	Staff - Faculty
External Co-PIs	Peter Kedron at University of California, Santa Barbara
Review Type	Exemption
Approval Status	Exemption Verified (1) Educational Research
Submitted By	Joseph Holler
Date Received	08/26/2023
Date of Completion	09/19/2023
Date Approved	09/19/2023
Check-In Deadline	09/18/2024
Proposed Start Date	09/11/2023
Federally Funded	Yes
Funding Source	National Science Foundation
Grant Number	BCS-2049837
Subjects	• None of the above

## (1) Educational Research Questions

Date Last Updated: 08/26/2023 12:21 AM EDT

Is this research project conducted in an established or commonly accepted educational setting?

Answer: ☒ 1. Yes  
☐ 2. No

Is the research unlikely to adversely impact the students' opportunity to learn required educational content?

Answer: ☒ 1. Yes  
☐ 2. No

Is the research unlikely to adversely affect the assessment of the educators' performance as teachers?

Answer: ☒ 1. Yes  
☐ 2. No

Is the research unlikely to adversely impact the ability of educators to assess student learning?

Answer: ☒ 1. Yes  
☐ 2. No

Which types of activity does this study involve (check all that apply):

Answer: ☒ 1. Research on regular and special educational strategies  
☒ 2. Research on the effectiveness or comparison of instructional techniques, curricula or classroom management methods  
☐ 3. None of the above

Pre-Protocol Questionnaire	08/26/2023 Pre-Protocol Questionnaire.pdf
Consent Form	08/26/2023 Consent_Survey.pdf 09/18/2023 Revised Qualtrics Survey for Consent to use Course... 09/18/2023 Informed Consent Protocol.pdf
Survey Instruments	08/26/2023 Surveys_Combined.pdf
Recruitment Materials	08/26/2023 IRB_Contact_Email.pdf
Site Permission Forms	08/26/2023 UCSB_Permission.docx
Grant Proposal	08/26/2023 NSF transforming theory and STEM education through...
Notifications	09/15/2023 Revisions Required - IRB ID: 259.pdf 09/19/2023 Exemption Notification - IRB ID: 259.pdf
Approved Application Sections	09/19/2023 Approved Application Sections.pdf

## Personnel

PI

**PI Documents** CITI ✓

- IRB Human Subjects Training Certification

Curriculum/Group/Stage

Basic/Refresher Course - Human Subjects Research / Social/Behavioral Research Course / 1 07/03/2027

Basic/Refresher Course - Human Subjects Research / Social/Behavioral Research Course / 1 07/08/2024

File

 citi\_holler.pdf 06/30/2027

**Proposal Basics**

**Project summary:**

*(Briefly summarize your project in non-technical language. You will have opportunities later in this application to describe the project in detail, including uploading documents if necessary. This summary is intended to introduce your project to the IRB.)*

**Answer:** Suggested Word Count Limit: 500, Current Word Count: 108

The scientific community has increasingly acknowledged the importance of reproducibility and replicability.

Our research project is one of several across the sciences developing reproduction and replication studies, infrastructure to facilitate reproducibility, and curricula to teach reproducibility.

Now, it is time to design pedagogy for geography curricula to train the next generation of scientists in reproducible and replicable research methods.

The purpose of this research project is to use artifacts of public student work and a series of short online Qualtrics surveys to collect data on students' engagement with reproducibility and replicability and experience in courses teaching reproducible and replicable research methods in order to inform future pedagogical design.

**Study Site:**

*(Where will the study be conducted?)*

- Answer:**
1. Middlebury College Campus (please specify which campus and, if relevant and known, which building or room)
  2. Online survey platform (please specify which survey tools [e.g., MTurk, Prolific, Qualtrics, SurveyMonkey, etc.]. You will provide more detail later in this application)
  3. Another institution (please name and describe - e.g., Duquesne University, or Bristol-Myers Squibb)
  4. Another online method (please name and describe - e.g., Facebook, Twitter, a support forum for people with IBS, etc.)
  - ✓ 5. Some other location (please describe)

The site of the study data collection is the Qualtrics survey platform and the public GitHub.com website.

The participants are students enrolled in advanced geography methods courses at Middlebury College (BiHall, Middlebury College main campus) and the University of California, Santa Barbara.

**Cooperating institutions:**

*(Will you need permission from a cooperating institution to perform this study? If you will perform your research at any place other than your home institution, the answer is YES.)*

**Answer:** ✓ Yes

No


**Name of cooperating institution:**

University of California, Santa Barbara

**Attach proof of permission from cooperating institution:**

*(Attach the original letter or email of permission or support from the institution where you will do the work. For example, if you plan to recruit children through a school, you will need permission from the school. If you do not yet have proof, please attach an explanation. Note that some institutions may require IRB approval before they will give their permission. In that case, please attach a brief statement to that effect here, and the IRB may grant conditional approval pending the permission of the recruitment site.)*

**Answer:**

 UCSB\_Permission.docx 08/26/2023 (Site Permission Forms)

**Recruitment and Consent**

**Subjects:**

*(Describe the target population from which you will recruit your subjects, and specify the inclusion and exclusion criteria you will be using. For example, you may be studying college students at Middlebury who are 18 years or older, or children of recent immigrants to the United States who do not speak English and are between 25 and 35 years old.)*

**Answer:**

The target population for this research is students enrolled in advanced geography methods courses at Middlebury College and University of California, Santa Barbara.

Participants under the age of 18 are excluded from the study, and are very unlikely to have met the prerequisites for registration in the target courses.

**Estimated number of subjects:**

*(Please provide a range - e.g. 150 - 175 - if you do not have a specific and exact number of subjects you will be recruiting. If you do have a specific number, please provide that here.)*

**Answer:**

The fall 2023 course at Middlebury has 21 students enrolled.  
Enrollment in future courses is unknown, but likely between 5 and 25.

**Recruitment**

*(Briefly, how will you contact individuals and invite them to participate in your research?)*

**Answer:**

Students have heard about the course through word of mouth and recommendation of other academic advisors. The research project will be introduced on the first day of class, and students will be invited to complete the first survey in class. Emails will be concise, and are attached to this protocol as IRB\_Contact\_Email.pdf. Students enrolled in the course will receive an email invitation to the survey based on a Qualtrics distribution list built from the class roster. The researcher/professor will step outside of the classroom for the duration of the survey so that participation will remain anonymous.


**Recruitment materials:**

*(If you will be using recruitment materials such as flyers, posters, or on-line postings, please upload a copy of all such materials to be used here.*

*If you are only using on-line recruiting and include the full and complete text of that posting in the **Recruitment** question above, you do not need to upload another copy here.*

*To continue without attaching a file, please click SAVE below.)*

**Answer:**

 IRB\_Contact\_Email.pdf 08/26/2023 (Recruitment Materials)

**Deception:**

*(Will your research require that you deceive your subjects to get the data you want?)*

**Answer:**

- Yes, deception is required  
☒ No, deception is not required

**Compensation:**

*(How are you compensating your participants for their participation? Be as specific as possible. If you are not compensating your participants, please indicate that here as well.)*

**Answer:**




There is no material compensation for participation.  
However, we hope that the students will enjoy a transformational educational experience and benefit professionally from the skills and lessons taught.

**Consent**

*(Please indicate how you will obtain your subjects' consent. For most studies, that means that consent will be either through a signed paper or electronic form or, for minimal risk online studies, by seeking informed consent at the start of the survey.*

*If your subjects are unable to give legal consent themselves (i.e., they are younger than 18 or cognitively impaired), you must get both written consent from a guardian and oral assent from the subject.*

*Some elements of informed consent can, under limited circumstances, be waived. See [here](#) for a discussion of the circumstances under which informed consent can be waived, and [here](#) for a discussion of when it would be appropriate to waive the documentation of informed consent.*

-  [Click here for a sample written consent form](#)  
 [Click here for a sample survey consent document](#)  
 [Click here for a sample oral consent script](#)

*You will be asked to attach your consent form or script later in this application.)*

**Answer:**

- I will obtain written informed consent.  
☒ I will obtain electronic informed consent.  
I will obtain both written consent from guardians and oral or written assent from subjects.  
I will obtain oral consent.  
I request a waiver of informed consent.  
I request a waiver of documentation of informed consent.  
My study will be conducted solely online, and participants will consent online by reading a consent statement and indicating their consent without providing their name

**Written or Electronic Consent:**

*(Please attach your consent form)*

**Answer:**

09/18/2023 2:00 PM EDT

## Methods

### Project Goals:

*(Please briefly describe your project's goals, including the research question(s) to be addressed. You may attach diagrams, figures, or illustrations below if that would be useful in helping the IRB understand your project.)*

#### Answer:

The goal of the project is to assess pedagogical effectiveness and inform future pedagogical development by answering the following questions about teaching open and reproducible research practices (ORRP) through longitudinal surveys and evaluation of student work.

1. Is the teaching design effective at increasing awareness of ORRP?
2. Are students able to apply ORRP effectively in the course?
3. Do students continue to apply ORRP in other courses or future work?
4. Does teaching ORRP increase scientific literacy?
5. Do students gain confidence in scientific research skills?
6. Does teaching reproduction and replication studies work as project-based learning?
7. Are the benefits of project-based learning also achieved while teaching ORRP and reproduction/replication studies?

### Attach Goals File?

*(Do you need to attach a file to provide additional information about your project goals? This is entirely optional, and most projects will not require additional documentation.)*

**Answer:** Yes, I have one or more files to attach to further explain my project goals

☒ No, my project goals were explained sufficiently above

### Which methods will you use to collect data from participants?

*(check all that apply)*

*Note that this question is asking how you will collect information, not to describe what is done to the subjects. For example, if you are testing the effectiveness of a new heart medication, you may be using survey information [to assess how subjects feel], and physiological data collection [to assess heart function].*

*If you were asking subjects to rate pictures of butterflies while measuring their heart rate, you would check the same two options - survey [picture ratings] and physiological [heart rate], even though the two studies are very different.*

**Answer:** Observation: you will watch participants and record data, but not necessarily interact with them directly.

Restricted/secondary dataset: you will use data that is not publicly available and was collected by other researchers.

Structured/semi-structured interviews: you will interact directly with participants to collect their answers to specific or general questions that you formulated beforehand.

☒ Survey, questionnaire, or test: you will distribute a paper or electronic survey, questionnaire, or test to participants. Note that if you are tracking their response or completion time, you should also check physiological data collection.

Physiological data collection (through the collection of physical samples, or the use of equipment or devices to measure or assess participants. This includes blood samples, fingernail clippings, EEG, ECG/EKG, weighing participants, etc.)

☒ Other

Please list:

Students post their coursework to public websites and repositories on GitHub.com. At the end of the course, I will use a very brief electronic survey (uploaded as the consent document) to solicit electronic consent for using the publicly visible coursework content on GitHub.com to assess teaching effectiveness.

Anonymous course evaluations are collected electronically for all Middlebury College courses. I will also use this anonymous information collected as normal educational practice in the research.

### Survey distribution and collection details:

*(How will you distribute and collect the surveys in a way that protects your participants' privacy and ensures that their participation is entirely voluntary? Please describe as specifically as possible how subjects will receive and submit their surveys.)*

#### Answer:

There are three surveys: 1) at the beginning of the course, 2) at the end of the course, and 3) one year after the course.

Surveys will be distributed electronically using Qualtrics. A distribution list of email address and random identification numbers is entered into Qualtrics based on the course roster and used to send email invitations for the first two surveys. The surveys do not ask any personally identifiable information and use the Qualtrics option to "Anonymize responses. Don't record respondents' IP Address, location data, and contact info." Participation is optional and participants can skip questions or close the survey at any time.

Following the second survey, a very short follow-up survey will serve only to ask participants for consent to reference their online public work on

GitHub.com in the research, and for an updated email address for the third survey. This survey contains the personally-identifiable information of participant email addresses, and will be used to store consent and to update the distribution list for the third survey. This email information is necessary to identify which public GitHub profiles I am permitted to use in the research and to contact students who may be graduating and changing their email address.


We use the Qualtrics API and the Qualtrics package for R to load a temporary version of the data, report aggregate demographic information, drop possible identifiers (e.g. affiliation with a minority group in science and engineering), and save a permanent de-identified version of data for analysis and archival.

We never save a permanent version of identifiable data outside of the password-protected Qualtrics database.

**Survey:**

*(Please attach a complete copy of the survey that you will use.)*

**Answer:**

 Surveys\_Combined.pdf 08/26/2023 (Survey Instruments)

**Other:**

*(Please describe the research methods that you will use in detail. If necessary, please attach additional documentation below.)*

**Answer:**

I will use students' GitHub content to enhance the evidence from surveys with qualitative data. In any case that I quote students or reference unique intellectual contributions, I will cite student's work appropriately to give them appropriate credit.

I will also code student work on GitHub for evidence of cognitive strategies for learning and Bloom's taxonomy of learning outcomes in order to report aggregate outcomes, e.g. "15 of 20 students demonstrated evidence of the "create" objective in Bloom's taxonomy..."

GitHub is designed for sharing intellectual work, including functions to "clone" (a fancy GitHub term for download) any repository to your local computer. Therefore I will "clone" students' public repositories to an external hard drive for evaluation purposes if they have provided electronic consent to do this via the consent Qualtrics survey.

I will use course evaluations to supplement surveys with anonymous qualitative data.

**Project method:**

*(Please describe your research method, being sure to address what the subjects will do, in what sequence, and about how long you anticipate the process will take for the subjects. You may attach diagrams or illustrations in the next question if those would be useful in helping the IRB understand your project methodology)*

**Answer:**

Research participants have enrolled a course on reproducible and replicable geographic research methods. At the beginning of the course, participants will be invited to complete a pre-course Qualtrics survey via email. We expect the survey to take up to 10 minutes.

The students will then proceed with the course as usual. In this course, students post all of their work publicly on the GitHub.com websites and repositories.

At the end of the course, participants will be invited to complete a post-course Qualtrics survey via email. We expect this survey to take up to 10 or 15 minutes.

At this time, we will send another short survey invitation by email: this one to ask for an email address to use in a future survey and to ask for consent to use students' coursework on the public GitHub.com website. If students consent to the use of their coursework, the work will be downloaded onto an external hard drive for storage and analysis. The consent process will remind students that they can delete or revise the content on GitHub after the course.

Finally, one year after the course concludes, we will send a final follow-up survey via email invitation. This final survey will also take up to 10 or 15 minutes.

**Additional method file(s):**

*(Please attach any additional files needed to explain the methodology of your project. If you've changed your mind and don't have additional files to attach, just click SAVE, below)*

**Answer:**

**Grant funded?**

*(Is your project funded by a grant? Or are you applying for a grant to fund this project?)*

**Answer:** ☒ Yes, this project is funded by a grant, or I am or will be applying for a grant to fund this project  
☐ No, this project is not and will not be funded by a grant

**Grant proposal:**

*(Please attach your grant proposal here. If you do not yet have a grant proposal available, please leave this blank for now and update the IRB with your grant proposal when it is available. To continue without attaching a document, please click SAVE below.)*

**Answer:**

 NSF transforming theory and STEM education through... 08/26/2023 (Grant Proposal)

**Other documentation?**

*(Do you have any other files to upload that the IRB may require to understand your project? Most projects do not require additional*

documentation.)

- Answer:** Yes, I have additional documentation to upload
- ☒ No, I do not need to upload any additional documentation

## Privacy and Confidentiality

### Anonymity and confidentiality:

*(Will your data be collected anonymously, confidentially, or neither?)*

*Anonymous data collection means that the data is collected in such a way that it can NEVER be connected to individual persons, and even you won't know which participant provided which data.*

*Confidential data collection means that you will protect your subjects' identifying information from access by anyone besides yourself, your co-PIs, and/or your faculty advisor. )*

- Answer:** Data will be collected anonymously
- ☒ Data will be collected confidentially
- Data will be collected neither anonymously nor confidentially

### Will identifiers be removed?

*(After you have collected your data, will you remove the information that identifies specific subjects from your dataset, such that no one would be able to trace the study data back to a specific person?)*

- Answer:** 1. Yes, identifiers will be removed.
- ☒ 2. No, identifiers will **not** be removed.

08/26/2023 1:09 AM EDT

### Will you take video recordings or photographs of your participants?

- Answer:** 1. Yes, we will take video recordings or photographs of our subjects.
- ☒ 2. No, we will not take video recordings or photographs of our subjects.

### Will you make audio recordings of your participants?

- Answer:** 1. Yes, we will make audio recordings of our subjects.
- ☒ 2. No, we will not make audio recordings of our subjects.

### Will you use personal (non-public) records as sources of data? Choose as many options as apply.

- Answer:**
1. Drug & alcohol records
  2. Educational records
  3. Health care records
  4. Psychiatric records
  5. Other personal, non-public records
  - ☒ 6. No personal, non-public records will be used

### Plan to protect data:

*(Please describe as specifically as possible what measures you will take to ensure that your data are not accessible to anyone besides you [and your advisor, if you are a student]. Please address how the data itself will be stored [e.g. if hard copy, will files be kept in a locked location? If electronic, will files be stored via Middlebury's servers, OneDrive, Google Drive, etc.? Will electronic files be password protected or encrypted?])*

#### Answer:

Data will be stored on the password protected and ethics-compliant Qualtrics server. The project will be shared only with the PI and collaborators reported to this IRB protocol.

The surveys use the Qualtrics option to "Anonymize responses. Don't record respondents' IP Address, location data, and contact info." Survey data does not contain any personal identifiers.

Data can be linked across the three surveys using a random identification number.

The only link between the random identification number and contact email addresses is in a password-protected Qualtrics distribution list.

We use the Qualtrics API and the Qualtrics package for R to load and save permanent de-identified versions of survey data for analysis and archival. If numbers of any demographic groups are too small to prevent identification (e.g. if fewer than 5 students report affiliation with an underrepresented group in STEM), then we will report that data in aggregate and drop it from any versions saved outside of Qualtrics.

We will keep electronic consent to use coursework on GitHub in the Qualtrics database only. For those students who consent, a copy of their public GitHub data will be downloaded (cloned) onto an external hard drive for use in Dr. Holler's office. We will not make or archive any additional copies of this data because it is already public and archived on GitHub.com. The data will be qualitatively coded in a local NVivo database.

Anonymous versions of the data will be archived on GitHub.com and OSF.io.

## Risks and Benefits

### Civil liability:

*(Could participating in your study put a subject at risk of being sued?)*

Answer: Yes  
☒ No

### Criminal liability:

*(Could participating in your study put your subjects at risk of being accused of or punished for committing a crime?)*

Answer: Yes  
☒ No

### Financial or employment risk:

*(Could participating in your study negatively affect your subjects' financial or employment status?)*

Answer: Yes  
☒ No

### Social risk:

*(Could participating in your study negatively affect your subjects' reputation or social standing?)*

Answer: Yes  
☒ No

### Physical risk to you or others:

*(Could participating in your study pose physical risks to you, your subjects, their families, or anyone else?)*

Answer: Yes  
☒ No

### Stress:

*(How would you describe the possible effects of your data collection on your subjects?)*

Answer: A potentially stressful experience  
☒ Not at all stressful

### Risk analysis:

*(What immediate or long-term risks might participation in your research entail for your subjects? Think carefully about not only possible physical risks, but also psychological, legal, financial, or social consequences that could result from either participating or from accidental disclosure of such participation.)*

#### Answer:

We do not anticipate any significant immediate or long-term risks associated with this research. There is always a remote possibility of security breaches for databases like Qualtrics where personal information is stored. However, the survey does not ask participants about any risky information, and students' work is all public on GitHub.com.

### Benefits:

*(What benefits, if any, might participants get from your research? Please do not include any direct compensation paid to participants.)*

#### Answer:

Participants benefit from the research in the form of learning from an innovative curriculum. Additionally, by participating in the survey, participants will be able to have a more tailored course experience. Additionally, further contact after one year has been shown to increase uptake of open and reproducible research practices after courses.

### Benefits to discipline or society:

*(What benefits, if any, might come of your research for your discipline and/or society at large?)*

#### Answer:

We hope that there will be significant benefits to science and society. Transparency, openness, and reproducibility are increasingly recognized across disciplines and funding organizations as high priorities for the integrity of research and for equitable public access to research with social implications. In order to change the culture of research to adopt more open and reproducible practices, we are developing infrastructure, curricula, and workshops and outreach. This research will help us to improve our curricular components.

## Physiological Data Collection

### Exercise:

*(Will you require subjects to perform exercise? If so, at what level of exertion?)*

Answer: ☒ Subjects will not exercise

Yes, mild exertion  
Yes, moderate exertion  
Yes, strenuous exercise

Annual Reviews

Year	Status	Due Date	Date Received	Date Approved	Submitted By
1	Due	09/11/2024			

Total # Subjects Enrolled Since Last Annual Review:  
Total # Subjects Enrolled in Study to Date:  
Total # Subjects Who Have Died: 0  
Total # Subjects Who Have Completed Study:  
Total # Subjects Still Active:  
Continuation Status:  
Unforeseen/Adverse Events: None  
Describe Unforeseen/Adverse Events:  
Additional Comments:

Amendments

Adverse Events

Report Date	Relatedness	Status
No Adverse Events Found.		

Protocol Deviations

Status	Protocol Deviations File/Comments	Submitted By
No Protocol Deviations Found		