How to Set Up and Conduct an Experiment

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An Overview of the Research Process

This document is a research crash course that walks you through the different stages included in research:

- Finding a proper research question

- Setting up your study to address the research question

- Having IRB review your study

- Collecting data

- Analyzing the data

- Writing a report

- Sending the work to the target venue and address reviews.
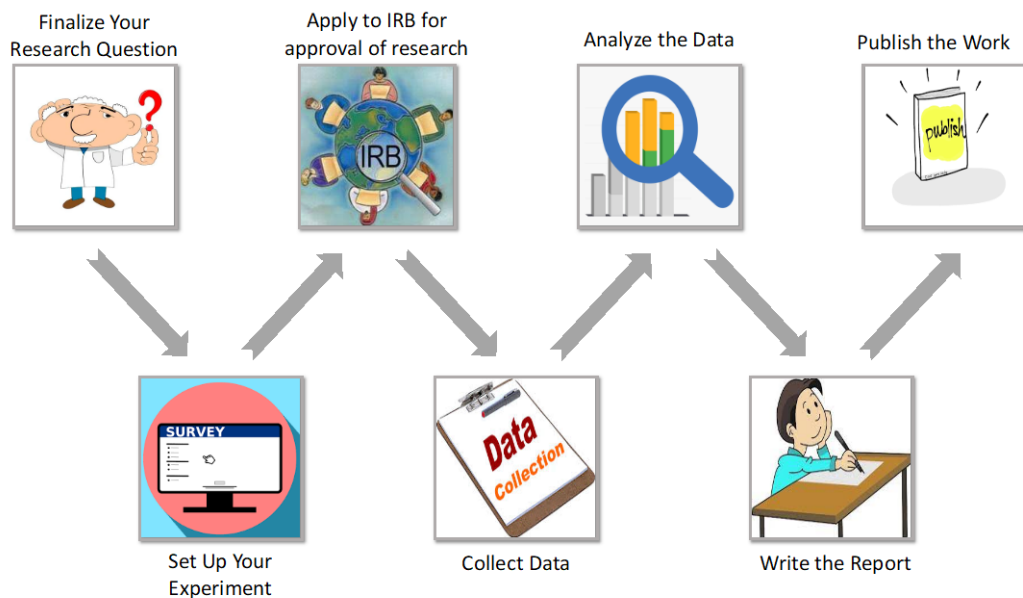
Research Question

Developing a clear and concise research question is the first stage of research. The experiment that you design will be your attempt to address this research question. A good research question should clearly specify the problem.
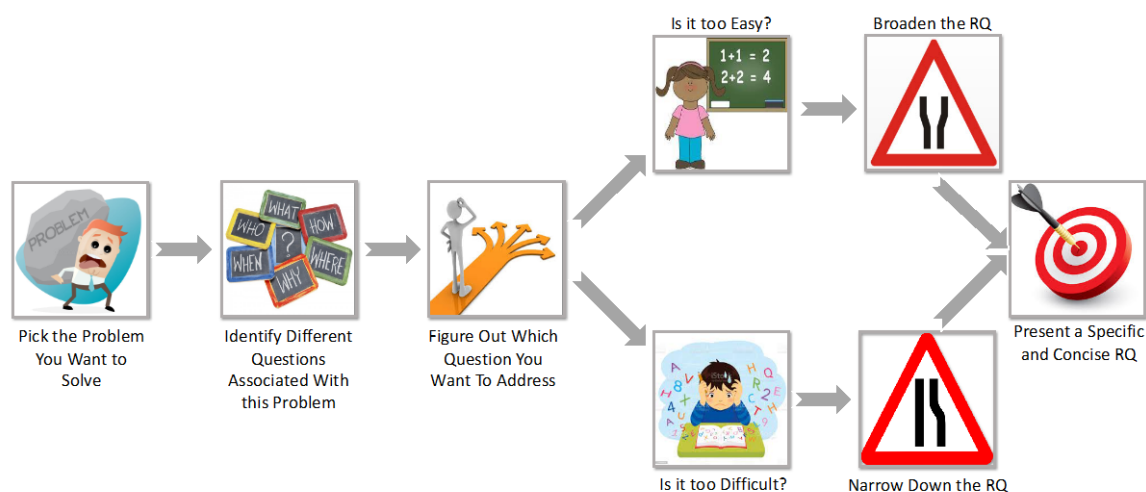
Neither too wide, nor too narrow

Prepare. One of the most challenging aspects of research involves choosing a topic. You can browse the databases associated with your field to discover new angles, hot topics or interesting problems in your area. Check Clemson's A-Z Databases for ideas to spark your imagination. After you research, you may want to brainstorm or draw a concept map to help you begin to see the possible directions that your research could take. Lab sessions are usually a great place for this brainstorming and discussing your ideas. If you don't have regular lab meetings, chat about it with your advisor or email a faculty member and ask for a meeting.

Design your Question. Think about the scope of what you want to cover in your research. Some research questions are too broad and too ambitious to cover in one project. For example, "why do students fail a course" is too broad. The first problem is that it doesn't clearly define the students. "Student" covers a wide range of subjects from elementary school to college. The education system at each stage is different, and it may not be feasible to generalize a finding over all the levels. For example, the reason for failure in first grade may be irrelevant to the reason for failure at the graduate school level.

Furthermore, "a course" is too broad. Different courses have different requirements and need different styles. For example, math classes may need practice working on problems, while some science courses require a different studying style, such as investigating a concept from multiple angles. Therefore, this research question needs to be narrower in scope. However, an overly narrow research question may not be beneficial, as it is not generalizable at all. For example, "Why did

three students fail the practicum course in Fall 2021" is too narrow as it only focuses on a course presented at a specific date. The results of such a narrow research question may not be very informative unless they are treated as case studies.

Neither too easy to answer, nor too difficult

Determine work and time constraints. Addressing your research question should require a realistic amount of work. You must be able to answer the question thoroughly within the given timeframe and word limit. For example, the research question should not be too ambitious (e.g., "how can I solve all humanity's problems"). It also should not be very simplistic and quick. For example, the question should require that you consider a complex range of interrelated questions (e.g., "how can I solve the problem of plastic waste in Lake Hartwell").

Set Up Your Experiment: Choosing the Right Methodology, Qualitative or Quantitative
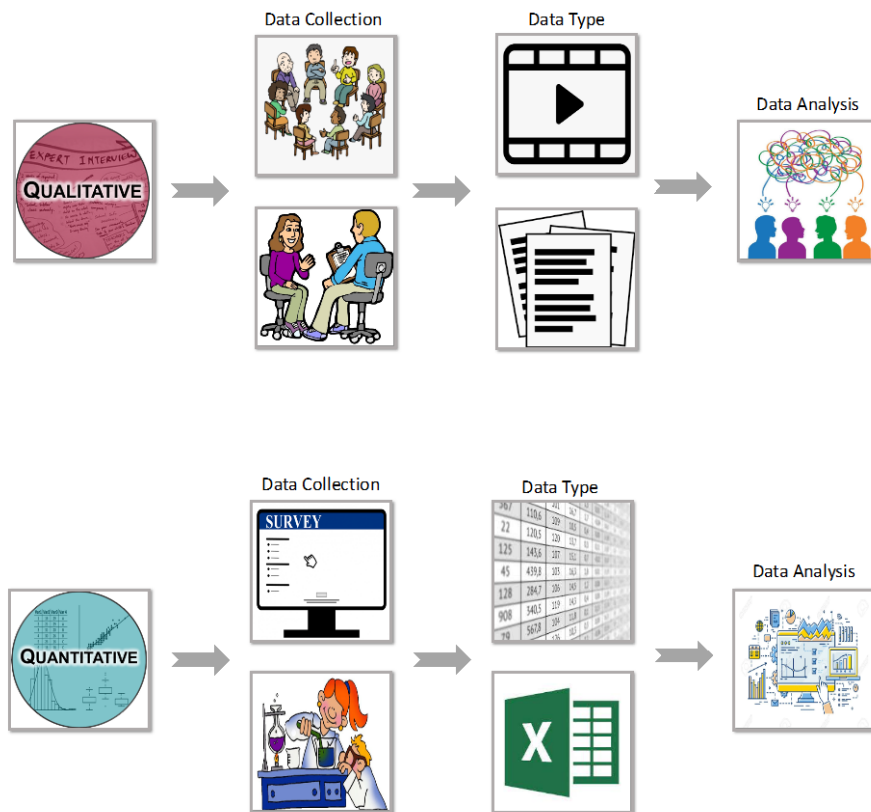
Two of the major methods you can use to address a research question are conducting a qualitative or quantitative study:

Qualitative research is concerned with observational data, interviews, questionnaires with open-ended questions, focus groups, participant-observation, recordings made in natural settings and documents.

Quantitative research is concerned with quantifying the collection and analysis of data. In quantitative research, you usually test a hypothesis or study relationships between variables with a large-scale sample.

Neither of the approaches is superior to the other one. These two approaches have different applications. Qualitative studies provide you with tools to more deeply investigate a topic. Quantitative studies enable you to study a larger sample in a shorter time. You can read more about these two approaches here.

Your study may also call for Mixed Methods research. Alan Bryman's "Integrating quantitative and qualitative research: How is it done?" may be helpful to you.

The methods should suit the research question

It is important to use the methodology that suits your research question. Qualitative approaches are usually the best methods for exploratory research, such as studying the common parameters that cause students to have lower performance in a given class. Quantitative approaches, however, are usually a great choice for more direct research questions where scholars only are studying the effects of some variables on other variables, such as studying how stress can relate to student performance in a given class.

Institutional Review Board

Receive IRB Training and Certificate → Create a Document Where You Explain Your Research → Submit The Documents to the IRB Office and Address their Concerns → You May Need to Ask Your Participants to Sign an Informed Consent Form
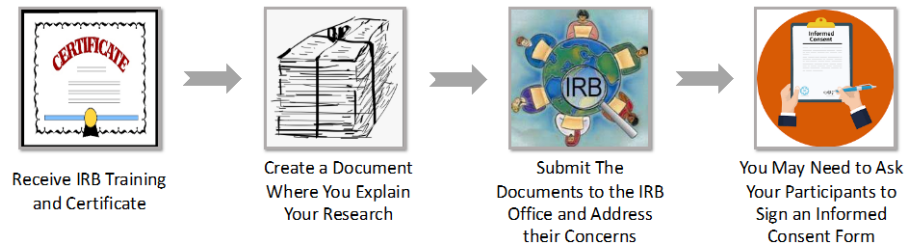
The IRB is a federally mandated body established under the United States Department of Health and Human Services' regulations for the Protection of Human Subjects (45 CFR 46). The goal of the IRB office is to protect the human subjects recruited to participate in research activities conducted under the auspices of Clemson University. Therefore, researchers should seek the IRB's approval for research prior to conducting any studies with human subjects. Here is a quick checklist to see if your research would require IRB approval; I used this source to create it:

☑ Your project should involve "research":

"Research" means a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge. However, if you are conducting class assignments that are to satisfy a course or graduation requirement and the results will not be shared externally, you do not need IRB review. If you are aiming for a conference or a journal submission, you are probably doing research.

☑ It should involve "human subjects":

"Human subject" means a living individual about whom, or with whom, an investigator (whether professional or student) is conducting research, which:

a) Obtains information or biospecimens through intervention or interaction with the individual, and uses, studies or analyzes the information or biospecimens; or

b) Obtains, uses, studies, analyzes or generates identifiable private information or identifiable biospecimens.

So, if you are not collecting identifiable information but are studying human subjects (e.g., a survey about their purchasing behavior), you would still need to contact the IRB and ask them to review your materials.

The IRB office has a pre-screening process. You can check your study with them prior to an official submission. Here is Clemson's IRB office FAQ page.

IRB training

All research team members should receive IRB training. This training is online through a portal and may take up to two hours. Depending on the type of research, the training may be different. Most researchers have to complete the social and behavioral science research course entitled "Group 1 Investigators Conducting Social and Behavioral Science Research (SBR) at Clemson University." However, scholars conducting biomedical research studies should complete the "Group 2 Biomedical Research" course.
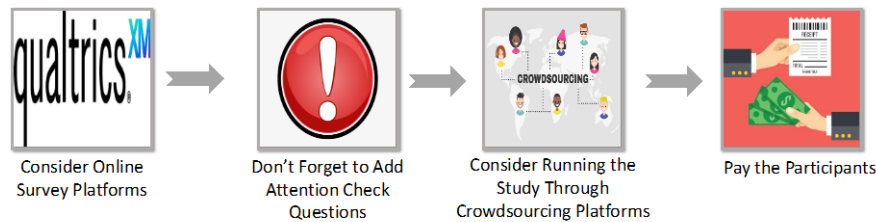
After these pieces of training, you will receive a Collaborative Institutional Training Initiative certificate. You will need to attach your certificates to any IRB applications.

IRB submission

After you have figured out your research protocol, you will need to seek the IRB's approval. You will fill out an online form available here. In this form, you explain your experiment and its different steps. You will also submit all the stimuli, instruments and any other materials you will use in your investigation. After you make this submission, the IRB office will start reviewing your materials and contact you to ask for more clarification or let you know that your submission is approved.

Please refer to Clemson's website to receive a Collaborative Institutional Training Initiative certificate to read more about the IRB procedures.

Collect Data: Tips for Conducting Online Quantitative Studies

| Consider Online Survey Platforms | Don't Forget to Add Attention Check Questions | Consider Running the Study Through Crowdsourcing Platforms | Pay the Participants |

Qualtrics as a survey platform

Many experiments involve surveys as well. Traditionally, researchers used to print survey questions and either hand them to respondents or post them. Online survey design systems are a blessing that can help make this process extremely easy. Qualtrics is one such system with many capabilities. Clemson University provides free Qualtrics accounts for students and faculty members.

Please refer to the CCIT's website for more information about Qualtrics.

Recruit participants through crowdsourcing platforms

If you can run the study online and remotely recruit participants, crowdsourcing platforms are a great option for participant recruitment. MTurk, Prolific and Microworkers are some common examples of such platforms. Here is a summary of the procedures to run your study on such platforms:

1. Create an account on the crowdsourcing platform.
2. Figure out how long it takes for a participant to finish your study. You can test your study with your friends. For example, ask them to run your study and give you feedback, including the time it took them to finish your study. You will need to know the duration as you want to offer a fair incentive for your study depending on its duration. The standard hourly compensation for these platforms is between 7 to 10 USD.
3. Figure out the number of participants that you want to recruit and add the required balance to your account. Please note that the crowdsourcing platforms also usually charge a service fee.
4. Create a project, specify the number of individuals you need to recruit and add some descriptions of your project.
5. Run your study. These platforms are usually quick, and you may be able to recruit even up to 1,000 participants over one day. After collecting data, it's time to verify participants' responses and pay them. I usually have several "attention check" questions in my studies. This helps me filter out those who did not read the questions or did not pay attention to the experiment or survey.

Analyze the Data

I won't explain the procedure of data analysis here, as there are many courses on campus for this reason. However, I introduce some classes that can help you gain this skill.

Qualitative data analysis

You can find qualitative data analysis classes in the following departments:

- Department of Communication
- Department of Industrial Engineering

Reference book:

- Charmaz, K. (2014). *Constructing grounded theory*. Sage Publications.

Quantitative data analysis

You can find qualitative data analysis classes in the following departments:
- School of Computing, measurement and evaluation 1 & 2. The website that I added has great slides. There is also a data science course that has a similar syllabus.
- Department of Psychology
- School of Mathematical and Statistical Sciences
- Department of Industrial Engineering

Reference book:

- Field, A., Miles, J., & Field, Z. (2012). *Discovering statistics using R*. Sage Publications.

Write the Paper

By this stage, you already have parts of your paper. Your research question and why it is essential are part of the paper's introduction section.

- Abstract: Present a short summary of the paper and what you find. This is your elevator pitch.
- Introduction: Briefly introduce the reader to your ideas and overall research question. Tell the readers why this research question is important and how you contribute to the conversation about the field.
- Background (literature review): Review the literature that relates to your work. You want to show how your study builds on the existing body of knowledge.
- Hypotheses development: Specify how you build your hypotheses (or research questions) concerning the literature. Sometimes researchers merge this section with the background.
- Research methods: Specify how you carry out your research. For example, are you using a survey? What are the instruments that you use?
- Results: Communicate your findings.
- Discussion: While the results are only for factual data, you can discuss your opinions in the discussion section. Say what your findings mean. Revisit your introduction here and say how these findings address your research questions and the implications.
- Limitations: Nothing is perfect, including your study. Say what you would do differently if you re-do this research or list the limitations you could not account for.
- Conclusions: Summarize the entire work and highlight the takeaway. You wrap up the paper and your main thoughts in this section.

The best way to know how to create a successful paper or journal article in your field is to read several examples (maybe the ones you are reading anyway for your lit review) and ask yourself "how did the authors put their argument together? What vocabulary did they use? How did they frame the argument? What evidence was most convincing and why?"

In other words, you can learn how to write your paper by reading for structure, not only for content; read expert papers for the organization and strategies, not only for what they say.

Publish the Work: Submit the Paper and Get into the Review Cycle
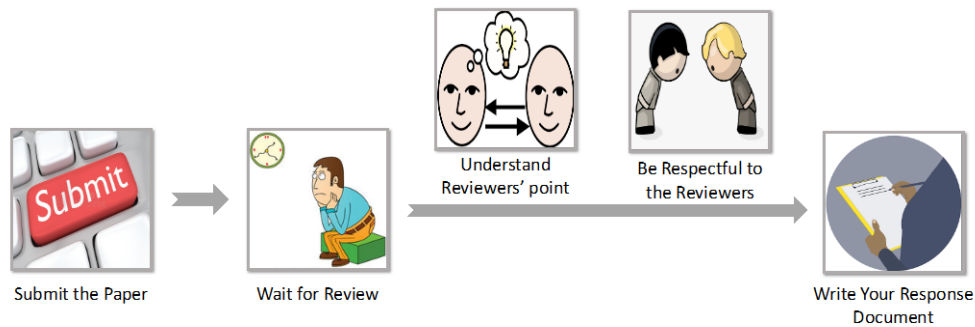
Some venues (e.g., major conferences) have submission deadlines that you should meet. To make the deadline, you should plan ahead and set milestones for yourself. For example, set a milestone for data collection way before the deadline to account for the time you need for data analysis and writing. However, some other venues do not have a submission deadline (e.g., many journals). Submission to these venues is easier in one aspect; you do not have to meet a deadline and can submit when you feel comfortable about your work. On the other hand, not having a deadline may prolong your research process.

After submitting, you will need to wait for reviews. There is no such thing as a negative review. They are all positive, even if they strongly criticize you. Remember, the goal of the reviewer is to help you see the shortcomings of your work to address them. At first, it may not be easy to see things from other people's (here reviewers') perspectives, but when you begin to, the chances are that you can acknowledge their point and address it. Reviews to be very helpful. Even if they lead to a rejection of your work, they can help you re-frame the study and publish a stronger study.

In the cases that you do not get a rejection, you may have a chance to write a response document to the reviewers and revise your work for publication. In the response document, you should always respect the reviewers and acknowledge their effort in reading your work and giving you feedback. Then, you should find a way to address their concerns in the paper. The peer-review process is one of the main advantages of science, preventing pieces of research that are not yet ready or the ones that may have methodological flaws from being published. It also helps the authors refine their research and improve it.