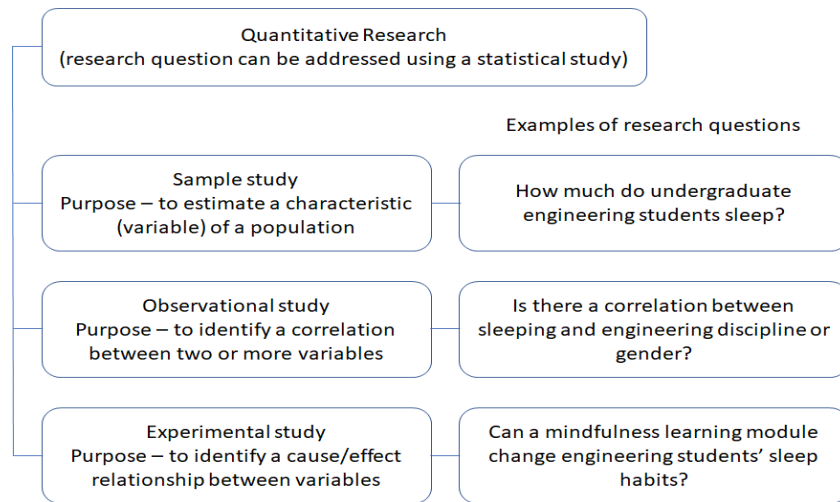


Statistical Studies: Quantitative Design

In engineering research we typically set up an experiment. There is a hypothesis or two, and we control the conditions of the experiment. We decide which parameters to hold constant and which will be varied. We manipulate the world (in a laboratory setting) to identify cause and effect relationships between variables. However, in engineering education research (EER), not all studies are experimental (see figure below).

A study, or part of a research study, may involve observing how the world works without interfering or “manipulating” the world. For example, we might survey our students to see how much sleep they get every night. Or we might identify the ways people teach in introductory courses and observe how students do in subsequent courses to see if there is a correlation. These types of studies are called sample studies and observational (or correlational) studies.

In a *sample study*, we are observing one parameter (e.g. sleep hours). We might look for a trend in this data; e.g., do students sleep less over time? In an *observational (correlational) study* we are looking for a correlation between two or more variables of interest; e.g. is there a correlation between year of study, discipline, and sleeping? Interestingly, observational studies do not always involve actually observing or surveying people. An observational study may involve, for example, analyzing students' grades, analyzing assignments or other assessments, or analyzing the comments teaching assistants make on student papers. In all of these cases we are looking at the world as it exists and operates, rather than changing up the “normal” flow of academic activity.



Observational studies cannot be used to prove a cause/effect relationship. We may find that fourth year mechanical engineering students pull more all-nighters, but we cannot infer that the fourth year mech eng curriculum causes this behavior. Maybe students who tend to pull all-nighters also tend to pick mech eng. We can only observe that there is a correlation.

Experimental studies are used to prove a cause/effect relationship. In an experimental study, subjects are assigned to groups, and their world is manipulated to see how the subjects are affected. This can be done ethically to answer some research questions, but not all research questions. For example, we could not randomly assign a group of students to one of eight disciplines of engineering to see if fourth year mechanical students pull more all-nighters. This would be unethical.

When you are designing a research study think about the research questions you are asking. Do they require an experimental study? Could they be accomplished using an observational study? What sources of data do you have available? This may help you shape a set of research questions and select a methodology that works best for your research goals, timelines, and so on.

Author: Susan McCahan, University of Toronto

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