

Research design

A research design is a systematic plan to study a scientific problem. The design of a study defines the study type (descriptive, correlational, semi-experimental, experimental, review, meta-analytic) and sub-type (e.g., descriptive-longitudinal case study), research question, hypotheses, independent and dependent variables, experimental design, and, if applicable, data collection methods and a statistical analysis plan. Research design is the framework that has been created to seek answers to research questions.

Design types and sub-types

There are many ways to classify research designs, but sometimes the distinction is artificial and other times different designs are combined. Nonetheless, the list below offers a number of useful distinctions between possible research designs.

- Descriptive (e.g., case-study, naturalistic observation, Survey)
- Correlational (e.g., case-control study, observational study)
- Semi-experimental (e.g., field experiment, quasi-experiment)
- Experimental (Experiment with random assignment)
- Review (Literature review, Systematic review)
- Meta-analytic (Meta-analysis, i.e., using statistical methods for contrasting and combining results from different studies to identify patterns among study results, sources of disagreement among those results, or other interesting relationships that may come to light in the context of multiple studies)

Theoretical versus experimental research.

Fixed versus Flexible research. In fixed designs, the design of the study is fixed before the main stage of data collection takes place. Fixed designs are normally theory driven; otherwise it is impossible to know in advance which variables need to be controlled and measured. Often, these variables are measured quantitatively. Flexible designs allow for more freedom during the data collection process. One reason for using a flexible research design can be that the variable of interest is not quantitatively measurable, such as culture. In other cases, theory might not be available before one starts the research. An example of flexible research designs is Grounded theory research which is a systematic research process that works to develop "a process, and action or an interaction about a substantive topic".

Quantitative versus Qualitative research. Quantitative research involves measuring a phenomenon in multiple grades, whereas qualitative research usually requires Boolean measurements only. Suitability of a solution can be studied qualitatively, but comparison between candidate solutions requires quantitative observation.

Confirmatory versus exploratory research. Confirmatory research tests *a priori* hypotheses—outcome predictions that are made before the measurement phase begins. Such *a priori* hypotheses are usually derived from a theory or the results of previous studies. Exploratory research on the other hand seeks to generate *a posteriori* hypotheses by examining a data-set and looking for potential relations between variables. It is also possible to have an idea about a relation between variables but to lack knowledge of the direction and strength of the relation. If the researcher does not have any specific hypotheses beforehand, the study is exploratory with respect to the variables in question (although it might be confirmatory for others). The advantage of exploratory research is that it is easier to make new discoveries due to the less stringent methodological restrictions. Here, the researcher does not want to miss a potentially interesting relation and therefore aims to minimize the probability of rejecting a *real* effect or relation, this probability is sometimes referred

to as β . In other words, if you want to see whether some of your measured variables could be related, you would want to increase your chances of finding a significant result by lowering the threshold of what you deem to be *significant*.

State problems versus process problems

A distinction can be made between state problems and process problems. State problems aim to answer what the state of a phenomenon is at a given time, while process problems deal with the change of phenomena over time. An example of state problems is the types of failure in a communication system. An example of process problems is the build-up of packet queue under a particular communication scenario. State problems are easier to measure than process problems. State problems just require one measurement of the phenomena of interest, while process problems always require multiple measurements.

Experimental versus Non-experimental research

In a good experimental design, a few things are of great importance. First of all, it is necessary to think of the best way to operationalize the variables that will be measured. Therefore, it is important to consider how the variable(s) will be measured, as well as which methods would be most appropriate to answer the research question. In addition, the statistical analysis has to be taken into account. The researcher should consider what the expectations of the study are as well as how to analyse this outcome. Finally, in an experimental design the researcher must think of the practical limitations including the availability of data-set or experimental set-up that are representative of the real situations. It is important to consider each of these factors before beginning the experiment.

Non-experimental research designs do not involve a manipulation of the situation, circumstances or experience of the participants. Non-experimental research designs can be broadly classified into three categories. First, relational designs, in which a range of variables is measured. These designs are also called correlational studies. Correlation does not imply causation, and rather identifies dependence of one variable on another. Correlational designs are helpful in identifying the relation of one variable to another, and seeing the frequency of co-occurrence in two natural groups. The second type is comparative research. These designs compare two or more groups on one or more variable, such as the effect of gender on grades. The third type of non-experimental research is a longitudinal design. A longitudinal design examines variables such as performance exhibited by a group or groups over time.

A complete research may involve parts which conform to different categories mentioned above.

URLs: <http://www.nyu.edu/pages/classes/bkg/methods/005847ch1.pdf> and
http://www.sagepub.in/upm-data/28285_02_Boeije_Ch_02.pdf.

While product design/creation is very important, it is not the primary aim of research. It may be a by-product sometimes.