Research Question, Hypothesis, Objectives

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- The overall purpose of a study can be expressed in three ways:
  - as research questions
  - as hypotheses
  - as aims and objectives

  or a combination of these.

- Whether to use questions or hypotheses → depends on factors such as
  - Purpose of study
  - Nature of design and methodology
  - Audience of research (even taste and preference of reviewers, committee members, the Chair)

Research Question

The first step is to define the research problem → *most difficult and important step*

- What are known
- What are not known → knowledge gap
- Knowledge gap leads to research problem
- Present research problem in the form of questions

- A research problem → an area of concern or a *gap in existing knowledge*
  ⇒ points to need for further understanding and investigation
- Identify and state the problem in *specific terms*
- Identify *variables* in the problem situation and define them adequately
- Generate explicit research questions on relationships between important variables

Do not paint the problem in general terms:

- ***"little is known about ..."***
- ***"no research has dealt with ..."***

Examples of research questions: Try putting different words in blanks...

1. What is the effect of _____ on _____?

detergent ------- germination of seeds
temperature--------the volume of air

2. How/to what extent does the _____ affect _____?

humidity----------growth of fungi
color of a material----------its absorption of heat
fertilizer ----------the growth of plants

3. Which/what _____ (verb) _____?

detergent---------- makes ----------the most bubbles

Research questions →
- precise and specific
- state exactly what you are going to investigate

Problem statement

- A problem statement → a claim that outlines and briefly explains the problem; briefly addresses the research question
- Transform a generalized problem into a targeted, well-defined problem that can be resolved through focused research

Characteristics of a problem statement

- Address a gap in knowledge → What have been done in the past, and why further research is needed
- Identify and delineate research problem → Problem should render itself to investigation through collection of data
- Explain what researcher wants to solve and what questions he/she wishes to answer
- Convincing argument that available knowledge is insufficient to solve it
- Explains why the study is important
- Problem statement forms a foundation for further development of research proposal → Objectives. Methodology etc.

Main drawback of many proposals: ***Research question is not specific enough***

Hypothesis

Hypothesis

- An educated guess about how things work
- Declarative statement → predicts relationship between two or more variables, concepts, phenomena, things, events, etc.
- Predict a possible answer to the research problem or question
- "If-Then" statement → underlies whole research study
- Testable → you need to be able to measure both "what you do" and "what will happen."

Hypothesis formulation

- Identify and state the problem in *specific terms*
- Identify the *variables* in the problem situation and define them adequately
- Generating tentative guesses (***hypotheses***) about the relation of the variables or in other words the solution of the problem

A hypothesis is usually written like this:

"If _____[I do this]_____, then _____[this]_____ will happen."

(Fill in the blanks with the appropriate information from your own experiment.)

Example:

If soil temperatures rise, then plant growth will increase.

This leads to objective:

To study the effect of soil temperature on plant growth

Another example of a hypothesis:

"If rampart craters on Mars form because of groundwater, then we should see a correlation between groundwater and rampart crater distributions. "

Research Question vs Hypothesis

Research Questions

- Mostly used in qualitative research, although used nowadays in quantitative research
- Pose relationship between two or more variables but phrases the relationship as a question

Hypotheses

- Typically used only in quantitative research
- Based on theoretical framework
- Represents a declarative statement of relations between two or more variables (Kerlinger, 1979; Krathwohl, 1988)

Example:

Research Question:
What effect does sleep inertia have on the ability to detect change on a visual display?

Hypothesis:
Sleep inertia impairs the ability to detect change on a visual display.

Research Objectives

- *Goals are broad statement of what is ultimately to be accomplished*
- *Objectives are more specific aims which the project wants to achieve*

Goal / Aim

- Overall concept, more abstract
- Broad statement of what you want to accomplish

VS

Objectives

- S – Specific
- M – Measurable outcomes
- A – Achievable, attainable
- R – Realistic
- T – Time-bound, achievable in a specified time period

Goals/Aims are:

- Big and broad, even visionary
- General intentions
- Intangible
- Abstract
- Hard to measure

Objectives are:

- Narrow
- Precise
- Tangible
- Concrete
- Measurable

Characteristics of Objectives

- State objectives as outcomes/solution, not as process
- Objectives should specify the result of an activity
- Must collectively test all parts of hypothesis
- Two to five at the most
- Each must flow logically into the next
- None should be absolutely dependent on the outcome of an earlier objective

Research objective should lead to your methodology → If it does not, research objectives are not good enough

Objective can be written in different ways

The research objective of this proposal is to:

- test hypothesis H
- measure parameter *P* with accuracy *A*
- prove conjecture *C*
- apply method *M* from disciplinary area *Q* to solve problem *X* in disciplinary area *R.*

Examples of objectives:

- The research objective of this project is to measure the cross-section of the muon-nutrino interaction at 5 GeV accurate to 5%.
- The research objective of this proposal is to test the hypothesis that physical phenomena x,y,z dominate the chip formation process in the machining of brittle materials.

Example of aim and objectives

Aim

"The aim of this project is to determine how the elastic behaviour of a piece of bungee cord varied with applied load".

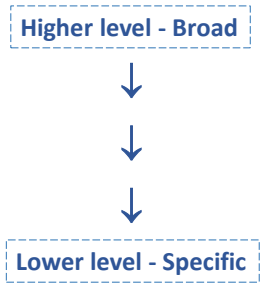
Objectives

1. To examine the relationship between spring constant and applied load.
2. To calculate the natural frequency from spring constant values, at various loads.
3. To compare an experimental value of natural frequency with a predicted value.

These words in objectives may not mean "fundamental research"

- Develop
- Design
- Optimize
- Control
- Manage

Hierarchy of objectives



Long term goal/aim: broad
To reduce birth defects among children of farm workers

Overall objective: narrower
To determine the cause of environmentally linked cleft palate (leap) syndrome

Specific Objective: narrowest
To determine the effect of herbicide "X" on the occurrence of cleft palate (leap) syndrome

Summary