Chapter 1

INTRODUCTION

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1- Practical Research: Planning and Design
  - Paul D. Leedy, Jeanne Ellis Ormrod
  - 10th Edition

2- Quantitative Research Methods
  - Mark Manning, Don McMurray
  - 3th Edition
The word *research* as it is used in everyday speech has numerous meanings, making it a decidedly confusing term for students, especially graduate students, who must learn to use the word in a narrower, more precise sense.

From elementary school to college, students hear the word *research* used in the context of a variety of activities.
In some situations, the word suggests to finding a piece of information or making notes and then writing a documented paper.

In other situations, “research” refers to the act of informing oneself about what one does not know, perhaps by searching through available sources to retrieve a bit of information.
Science is one of the types of knowledge which people can communicate to each other and share.

In an older and closely related meaning, "science" also refers to a body of knowledge itself, of the type that can be rationally explained and reliably applied.
The scientific method is a body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge.

To be termed scientific, a method of inquiry must be based on empirical and measurable evidence subject to specific principles of reasoning.

Scientific research relies on the application of the scientific method.
Scientific Method...

- Hypothesis
- Sequence of **experiments**
  - Randomization
  - Repetition
- Change one parameter/experiment
- Prove/Disprove Hypothesis
- Document for others to reproduce results

Taken from “How to have a bad career in research/academia” by David Patterson, Feb 2002.
Scientific Method...

Theory

Consistent

Observations ➔ Hypothesis ➔ Predictions

Not consistent. Modify hypothesis

Tests

From phyun5.ucr.edu/~wudka/Physics7
What Research is not?

❖ Research isn’t information gathering:
  ▪ Gathering information from resources such as books or magazines isn’t research.
  ▪ No contribution to new knowledge.

❖ Research isn’t the transportation of facts:
  ▪ Merely transporting facts from one resource to another doesn’t constitute research.
  ▪ No contribution to new knowledge although this might make existing knowledge more accessible.
What Research Is

“...the systematic process of collecting and analyzing information (data) in order to increase our understanding of the phenomenon about which we are concerned or interested.”

Research Characteristics

1. Originates with a question or problem.
2. Requires clear description of a goal.
3. Follows a specific plan or procedure.
4. Often divides main problem into sub-problems.
5. Guided by specific problem, question, or hypothesis.
6. Accepts certain critical assumptions.
7. Requires collection and interpretation of data.
Research Projects

- Research begins with a problem.
  - This problem need not be Earth-shaking.

- Identifying this problem can actually be the hardest part of research.

- In general, good research projects should:
  - Address an important question.
    - original and significant
  - Advance knowledge.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
The following kinds of projects usually don’t make for good research:

- Comparing data sets.
- Correlating data sets.
- Problems with yes / no answers.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Good research requires:

- The scope and limitations of the work to be clearly defined.
- The process to be clearly explained so that it can be reproduced and verified by other researchers.
- A thoroughly planned design that is as objective as possible.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
High-Quality Research (cont.)

- Good research requires:
  - Highly ethical standards be applied.
  - All limitations be documented.
  - Data be **adequately analyzed** and explained.
  - All findings be presented **unambiguously** and all conclusions be justified by sufficient evidence.

- Vocabulary - definition

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Exercise

- Graphic Organizer
  - A graphic organizer is a visual representation of concepts, knowledge, or information that can incorporate both text and pictures. Examples include calendars, maps, Venn diagrams, and flow charts. Graphic organizers allow the mind to see undiscovered patterns and relationships.

- Do a map of your research (5 minutes)

- Establish relationships
  - Use arrows
The world is filled with unanswered questions and unresolved problems.

Everywhere we look, we see things that cause us to wonder, to consider, to ask questions.

Consider the unresolved situations that bring to mind these questions:

- What is such-and-such a situation like?
- Why does such-and-such a phenomenon occur?
- What does it all mean?

These are everyday questions.

With questions like these, research begins.
Sources of Research Problems

- Observation.
- Literature reviews.
- Professional conferences.
- Experts.
- Previous experience

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Once you’ve identified a research problem:

- State that problem clearly and completely.
- Determine the feasibility of the research.

Identify sub-problems:

- Completely researchable units.
- Small in number.
- Add up to the total problem.
- Must be clearly tied to the interpretation of the data.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Sub-Problems

- Sample

- Main problem
  
  How do I get from Town A to Town B?

- Sub-problems:
  1. What is the most direct route?
  2. How far do I travel on the highway?
  3. Which exit should I take to leave the highway?
Hypotheses

- Hypotheses are tentative, intelligent guesses as to the solution of the problem.
  - There is often a 1-1 correspondence between a sub-problem and a hypothesis.
  - Hypotheses can direct later research activities since they can help determine the nature of the research and methods applied.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Delimitations

- All research has limitations and thus certain work that **will not** be performed.

- The work that will not be undertaken is described as the *delimitations* of the research.

  - **Scope**

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Define each technical term as it is used in relation to your research project.

- This helps remove significant ambiguity from the research itself by ensuring that reviewers, while they may not agree with your definitions, at least know what you’re talking about.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Assumptions are those things that the researcher is taking for granted.

- For example: a given test instrument accurately and consistently measures the phenomenon in question.

As a general rule you’re better off documenting an assumption than ignoring it.

- Overlooked assumptions provide a prime source of debate about a research project’s results.
Many research problems have a kind of theoretical feel about them. Such projects often need to be justified:
- What is the research project’s practical value?

Without this justification, it will prove difficult to convince others that the problem in question is worth study.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Research proposals are documents that describe the intended research including:

- Problem and sub-problems.
- Hypotheses.
- Delimitations.
- Definitions.
- Assumptions.
- Importance.
- Literature review.
A literature review is a necessity.
- Without this step, you won’t know if your problem has been solved or what related research is already underway.

When performing the review:
- Start searching professional journals.
- Begin with the most recent articles you can find.
- Keep track of relevant articles in a bibliography.
- Don’t be discouraged if work on the topic is already underway.
Be very careful to check your sources when doing your literature review.

Many trade magazines are not peer reviewed.

- Professional conferences and journals often have each article reviewed by multiple people before it is even recommended for publication.
- The IEEE and ACM digital libraries are good places to start looking for legal research.
Literature Review Pitfalls...

- The Internet can be a good source of information. It is also full of pseudo-science and poor research.

- Make sure you verify the claims of any documentation that has not been peer reviewed by other professionals in the computing industry.
Research Process

- Research is an extremely cyclic process.
  - Later stages might necessitate a review of earlier work.

- This isn’t a weakness of the process but is part of the built-in error correction machinery.

- Because of the cyclic nature of research, it can be difficult to determine where to start and when to stop.
Step 1: A Question Is Raised

- A question occurs to or is posed to the researcher for which that researcher has no answer.
  - This doesn’t mean that someone else doesn’t already have an answer.

- The question needs to be converted to an appropriate problem statement like that documented in a research proposal.
Step 2: Suggest Hypotheses

- The researcher generates intermediate hypotheses to describe a solution to the problem.
  - This is at best a temporary solution since there is as yet no evidence to support either the acceptance or rejection of these hypotheses.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Step 3: Literature Review

- The available literature is reviewed to determine if there is already a solution to the problem.
  - Existing solutions do not always explain new observations.
  - The existing solution might require some revision or even be discarded.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Step 4: Literature Evaluation

- It’s possible that the literature review has given a solution to the proposed problem.
  - This means that you haven’t really done research.

- On the other hand, if the literature review turns up nothing, then additional research activities are justified.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Step 5: Acquire Data

- The researcher now begins to gather data relating to the research problem.
  - The means of data acquisition will often change based on the type of the research problem.
  - This might entail only data gathering, but it could also require the creation of new measurement instruments.
Step 6: Data Analysis

- The data that were gathered in the previous step are analyzed as a first step in ascertaining their meaning.

- As before, the analysis of the data does not make up research.
  - This is basic number crunching.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Step 7: Data Interpretation

- The researcher interprets the newly analyzed data and suggests a conclusion.
  - This can be difficult.
  - Keep in mind that data analysis that suggests a correlation between two variables can’t automatically be interpreted as suggesting causality between those variables.

Taken from: Research Concepts by Chris Jones and Xiaoping Jia (minor modifications by Nayda Santiago)
Step 8: Hypothesis Support

- The data will either support the hypotheses or they won’t.
  - This may lead the researcher to cycle back to an earlier step in the process and begin again with a new hypothesis.
  - This is one of the self-correcting mechanisms associated with the scientific method.

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Thank You!