FemProf

What is Research?

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Objectives

- Students will be able to understand the fundamental elements present in research work.
- Students will identify different types of reseach.
- Students will recognize the difference between high and low quality research.

What is Research?

- Definition
  1. to search or investigate exhaustively
  2. studious inquiry or examination; especially : investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws
  3. the collecting of information about a particular subject

How is research defined by different people?

- Mike – freshman student
  - A drag
  - Searching the web the night before my paper's due

Taken from Online Library Learning Center

How is research defined by different people?

- Elizabeth – a third year student
  - Something that makes my professors happy when I do it.
  - What I start a week or so before my project's due.

Taken from Online Library Learning Center

How is research defined by different people?

- Bob – a graduating student
  - Something I wish they'd taught me when I first started college.
  - A skill that will help me get a good job or learn about subjects that will interest me in graduate school.

Taken from Online Library Learning Center

How is research defined by different people?

- Pat– PhD student
  - A way to find out what's already been written on my dissertation topic, or what areas provide opportunities for study
  - A great journey of investigation, full of surprises, loaded with fun – an a way to procrastinate on writing my dissertation.

Taken from Online Library Learning Center

How is research defined by different people?

- Martha – a mature student
  - A practical skill that will help me in many areas of my life like getting a degree, making decisions about big things like healthcare, investments, and major purchases, and learning about new things.
  - Something that's a little nerve-wracking with all those computers.

Taken from Online Library Learning Center

How is research defined by different people?

- Scully – FBI agent*
  - Knowing what questions to ask (Why did the killer leave one bloody glove? or What do the aliens do to these people they abduct?)
  - Figuring out who might have the answers.

*X-files TV series

Taken from Online Library Learning Center

Research

- Please read the quote from: Ho, D. 2007. "Research, Innovation and Knowledge Management: The ICT Factor".

Quote (Ho, 2007)

- "The creation of new knowledge or technology is also known as discovery or invention. Research is the scholarly work needed to arrive at finding new things or new knowledge. This is the process of creating value for knowledge. Critical success factors for research are quality, pertinence to societal or business needs or economic growth, and sustainability. We determine quality by its degree of excellence, superior to existing knowledge or products. Pertinence is defined by its degree of relevance to meet a business need, economic development or a societal challenge; its nature can be in the form of knowledge, technology or a solution. Quality and pertinence are among the attributes that define the value of the research outcome. Sustainability is determined by the research's ability to survive and grow. Without this, there is no future for research or activity of research."

What do you think?

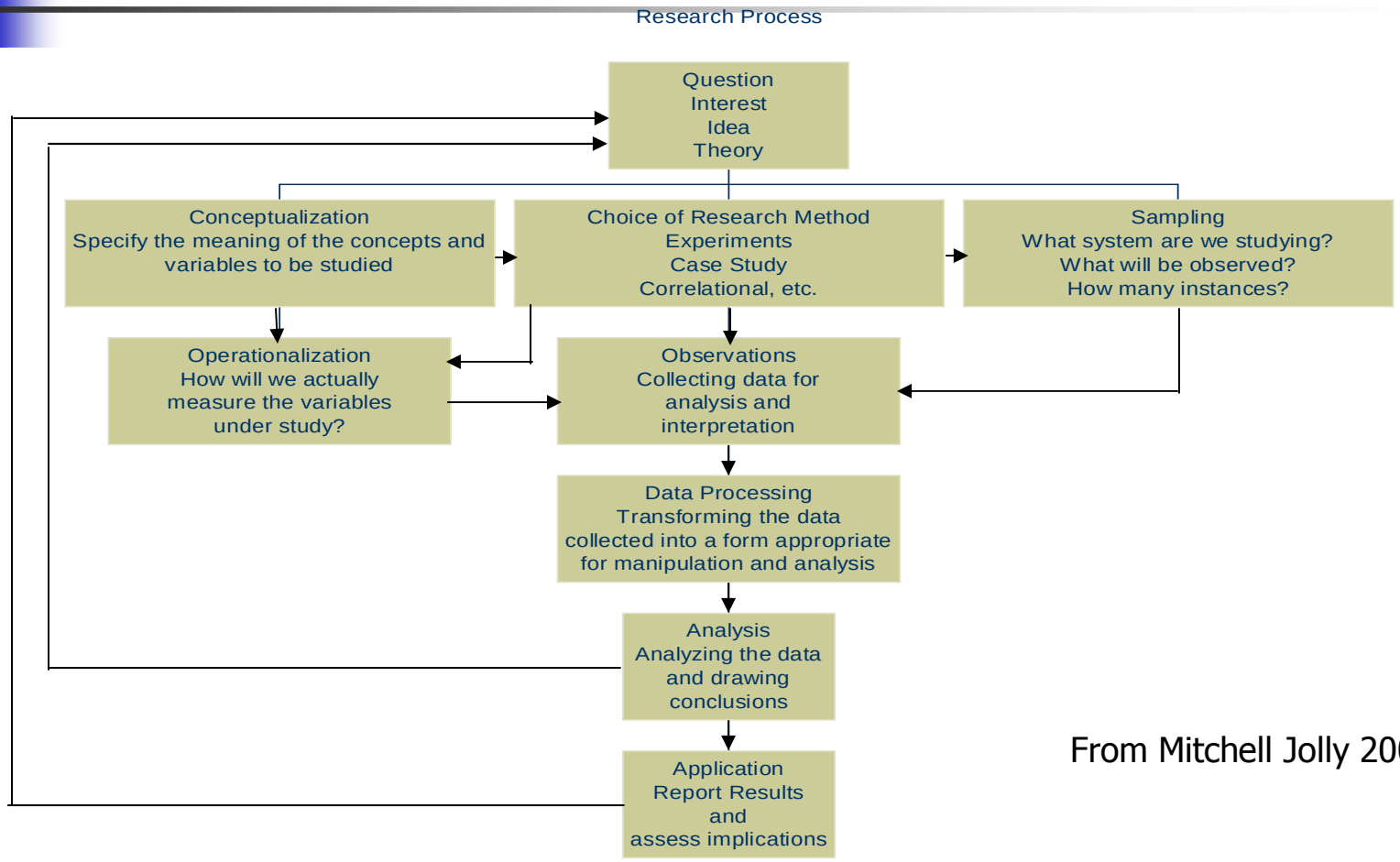
- What do you think about these quotes? Do they define some characteristics of research?
- Can you figure why redundant research is not seen as needed or consequential?

Quote from: Chronicle of Higher Education 2010

- "While brilliant and progressive research continues apace here and there, the amount of redundant, inconsequential, and outright poor research has swelled in recent decades, filling countless pages in journals and monographs."
  - What do you think about this quote?

Identifying essential components of research

The Research Process



From Mitchell Jolly 2004

Elements

Experimental

- Concepts
  - Literature review
- Experimentation
  - Statistics
  - Data collection
  - Data transformation
  - Interpretation and validation
- Report
  - Publication

Theoretical

- Concepts
  - Literature review
- Observation
- Proofs and derivation
- Validation
- Report
  - Publication

Combination

Let's see if we can identify these elements

Dr. Valenzuela's research work presentation

Answer questions in your handout.

Examples of Research Methods in Engineering and Science

- Survey
- Case Study
- Correlational Research
- Experimental Research

Survey Research

- Research in which people chosen to represent a larger population are asked a series of questions about their behavior, thoughts, or attitudes.
  - Infer how a larger group would respond

Case Study

- An in-depth, intensive investigation of an individual or small group of samples or population.
  - Emphasize detailed contextual analysis of a limited number of events or conditions and their relationships
  - Pros
    - Success in carefully planned and crafted studies of real-life situations, issues, and problems
    - Many reports on many disciplines
  - Cons
    - A small number of cases can offer no grounds for establishing reliability or generality of findings
    - Intense exposure to study of the case biases the findings

Case Study Steps

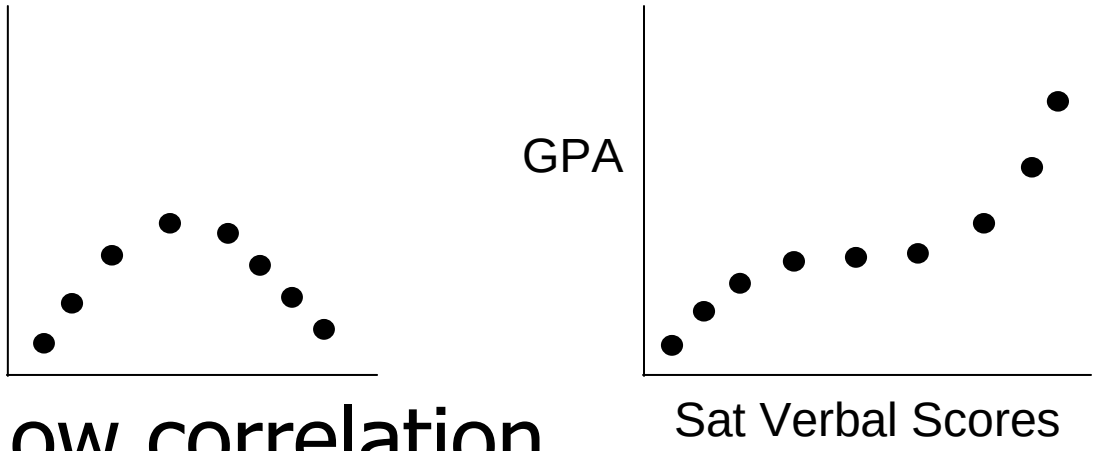
- Determine and define the research questions
  - The researcher establishes the focus of the study by forming questions about the situation or problem to be studied and determining a purpose for the study.
- Select the cases and determine data gathering and analysis techniques
  - Approaches to use in selecting single or multiple real-life cases to examine in depth and which instruments and data gathering approaches to use.
- Prepare to collect the data
  - Systematic organization of the data
  - Prevent the researcher from becoming overwhelmed by the amount of data
  - Prevent the researcher from losing sight of the original research purpose and questions.
- Collect data in the field
  - Collect and store multiple sources of evidence comprehensively and systematically
  - Patterns can be uncovered
- Evaluate and analyze the data
  - Interpretations in order to find linkages between the research object and the outcomes with reference to the original research questions.
- Report results
  - Convey to the reader evidence that all avenues have been explored
  - Establish boundaries

Correlational Research

- Variable: A measurable factor, characteristic, or attribute of an individual or a system.
- Research that examines the relationship between two sets of variables to determine whether they are associated or "correlated"
  - Linear relationship

Correlational Research

- Careful!!!



- Low correlation
- Non linear relationships

Correlational Research

- Non causal
  - More study time ⟶ Good grades
    - Highly correlated
    - Cause?
      - Interest in the subject → More study time?
  - Correlational studies
    - Strength of relation between two variables
    - Does not demonstrate cause-and-effect

Experimental Research

- **Experiment**: The investigation of the relationship between two or more variables by deliberately producing a change in one variable in a situation and observing the effects of that change on other aspect of the situation.
- Cause-and-effect

Experimental Research

- **Experimental manipulation**: Change that an experimenter deliberately produces in a situation
- **Treatment**: The manipulation implemented by experimenter
- **Experimental group**: Any group receiving a treatment in an experiment

Experimental Research

- In an *observational study*, measurements of variables of interest are observed and recorded, without controlling any factor that might influence their values.
  - Political Poll
  - Feeding habits of the Northern wolf.
  - Ant colony behavior
- An *experiment*, on the other hand, deliberately imposes some treatment on individuals in order to observe their responses.
  - In principle, only experiments can give good evidence for causation.

Experiment example

- *New* communication protocol improves throughput in the network.
- To assess the effect, researchers measure network latency over a period of a week.
- They randomly select the day when the protocol will be used comparing the new versus the old one.
- The same machines will be used in both.
- Same size files will be sent over the network.

Design of Experiments

- Experimental units: individuals on which the experiment is done, also called subjects when the units are human beings.
  - The network
- Treatment: the specific experimental condition applied to the units.
  - protocol
- Factors: the explanatory variables, which often have levels.
  - Old vs new

Principles of Experimental Design

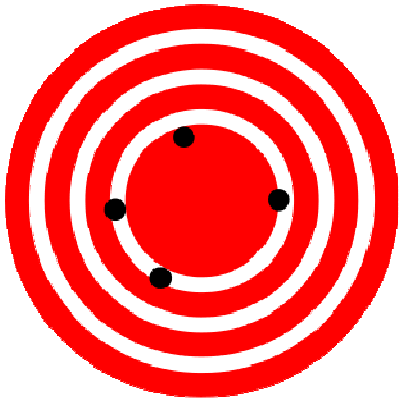
- Control
  - Researcher decides which subjects are assigned to the treatment group
- Randomization
  - Impartial and objective
- Replication
  - Reduces chance variation in the results and can help achieve statistical significance

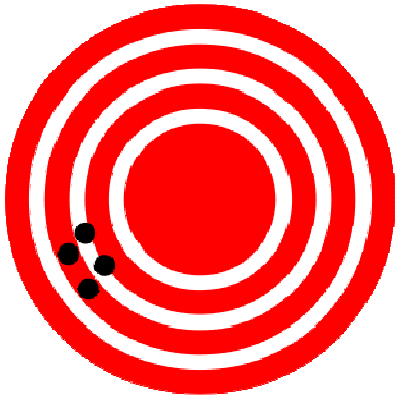
Validity

- The relative accuracy or correctness of the statements.
- Internal validity
  - Extent to which a set of research findings provides compelling information about causality
- External validity
  - Extent to which a set of research findings provides an accurate description of what typically happens in the real world.
  - Generalizability
- Conceptual validity
  - How well a specific research hypothesis maps onto the broader theory that it was designed to test.

Precision and Accuracy

- Precision
  - Consistency or repeatability of a measure or observation.
- Accuracy
  - Degree of conformity of a measured quantity to its actual value.





Summary

- Definition of research
- High quality vs low quality
- Example of research
- Types of research
  - Examples

References

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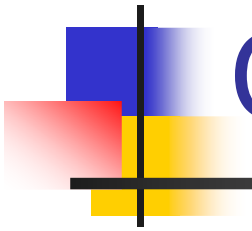

Questions?