Research Methodology

Research Design

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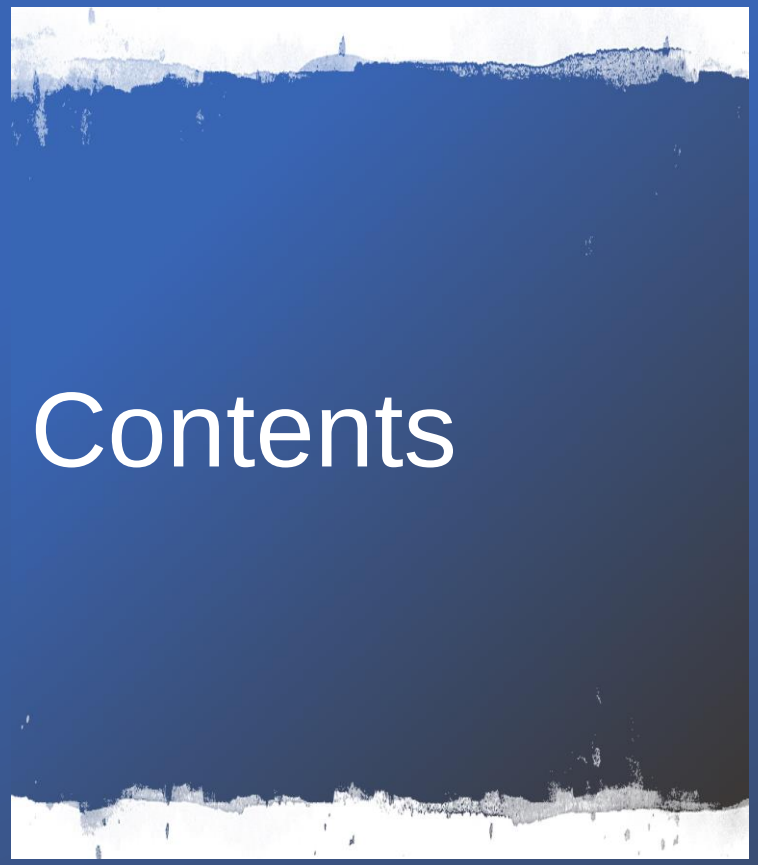


1) Definitions of Research Design

Concrete Definitions

- **Research design** is the "conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement, and analysis of data" [1].
- **Research design** is "a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems" [2].
  - A plan is the complete scheme or program of the research.
  - A plan includes an outline of what the investigator will do from writing the hypotheses and their operational implications to the final analysis of data.

General Definitions

- A **research design** is the framework or guide used for
  - Planning
  - Implementation
  - Analysis of a study
- A **research design** is systematic plan of
  - What is to be done
  - How it will be done
  - How the data will be analyzed

2) Functions of a Research Design

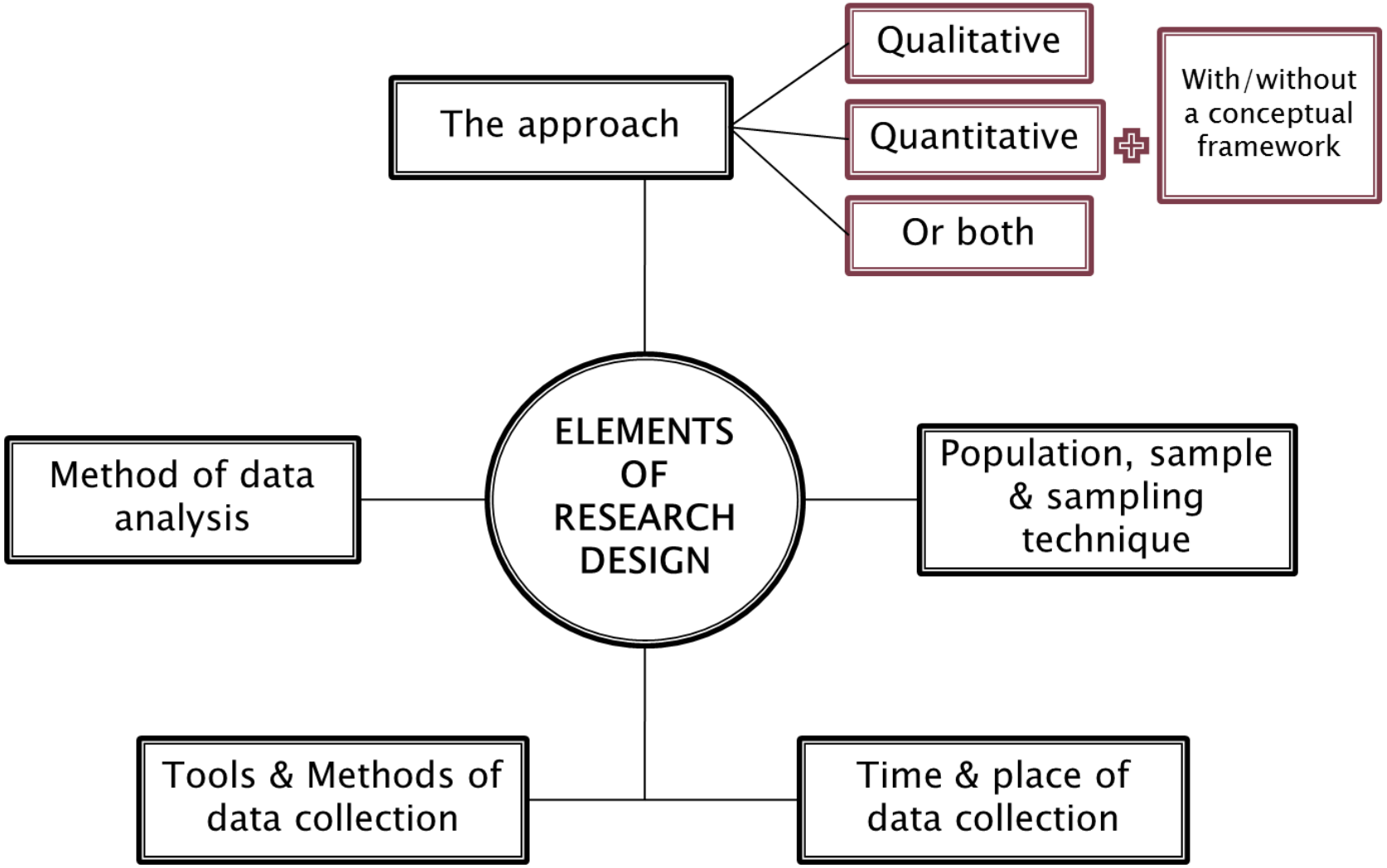
How many functions of a research design?

- A research design has two main functions:
  1) Conceptualize an operational plan to undertake
     - The various procedures and tasks required to complete your study
  2) Ensure that these procedures are adequate to obtain
     - Valid objective
     - Accurate answers to the research questions

How a Research Design tell us?

- A research design tells us:
  - When and how often to collect data
  - What data to gather and from whom
  - How to analyze the data
  - Examines the linkage, causation, or relationship
- A research design is different from one another based on
  - The selected research method

Elements of Research Design



Source [1]

3) Quality of a Study's Research Design

What is quality of a research study?

- Quality of a research study is called conclusion validity
- Conclusion validity refers to the extent of researcher's ability to
  - Draw accurate conclusions from the research
- The degree of a study's research design are:
  - Internal validity
  - External validity

Internal and External Validity

- **Internal validity**: correctness of conclusions regarding the relationships among variables examined
  - Whether the research findings accurately reflect
    - How the research variables are really connected to each other
  - Independent variable is responsible for variation of dependent variable
- **External validity**: generalizability of the findings to the intended/appropriate population/setting
  - It researches under what conditions and in which type of subjects the same results can be expected to be replicated, or whether the same intervention will work in another setting and with different subjects

How to achieve the internal/external validity?

- By effectively controlling 3 types of variances:
  - Variance of the independent & dependent variables (Systematic Variance)
    - ➢ Independent variable (IV): they are manipulated or change – cause
    - ➢ Dependent variable (DV): they are measured – effect
  - Variability of potential extraneous/confounding/nuisance variables (Confounding Variance)
    - ➢ Extraneous variable: uninteresting variable (might bring effect of IV on DV)
    - ➢ Confounding variable: uncontrolled/unmeasured variable (may cause effect)
    - ➢ Nuisance variable: a type of extraneous variable
      - ○ causes an increase in variability within groups in an experiment

How to achieve the internal/external validity?

- By effectively controlling 3 types of variances (cont.):
  - Variance attributable to error in measurement (Error Variance)
    - ➢ Difference between the actual value of a quantity and the value obtained by a measurement
    - ➢ Repeating the measurement will improve (reduce) the random error
      - Caused by the accuracy limit of the measuring instrument

3) Effective Research Design

Which one is a good guiding principle?

- The **MAXMINCON** principle is a good guiding principle for effective control of variances
  - **MAX**imize Systematic Variance
  - **MIN**imize Error Variance
  - **CON**trol Variance of extraneous/confounding/nuisance variables

MAXimizing Systematic Variance

- Widening the range of values of research variables
- In experiments studies:
  - Where the researcher
    - Manipulates the independent variable and
    - Measures its impact on the dependent variable
  - Proper manipulation of experimental conditions to ensure high variability in IV
- In non-experimental studies
  - Where independent and dependent variables
    - Are measured simultaneously and
    - Are examined the relationship between them
  - Appropriate subject selection – avoid Range Restriction

MINimizing Error Variance

- Minimizing the part of variability in scores
  - Is caused by error in measurement
- Sources of error variance:
  - Poorly designed measurement instruments (instrumentation error)
  - Error spreading out from study subjects (e.g., response error)
  - Contextual factors: reduce instrument's capacity to measure accurately
- How to Minimize Error Variance?
  - Increase validity and reliability of measurement instruments
  - Measure variables under as ideal conditions as possible

CONtrolling Variance of Variables

- What are Nuisance/Confounding (N/C) Variables?
  - May or may not be of primary interest to the researcher
  - But
    - Can produce undesirable variation in the study's DV and
    - Cause misleading or weird results
  - Thus, if not controlled
    - Can pollute/distort the true relationship(s) between
      - The independent and dependent variable(s) of interest

How to control N/C variables?

- In experimental settings
  - Conducting the experiment in a controlled environment (e.g., laboratory)
    - ➢Can hold values of potential confounding variables constant
  - Subject selection (e.g., matching subjects in experiments)
  - Random assignment of subjects (distribute experimental & control groups)
- In survey search
  - **Sample selection**: e.g., including only subjects with correct characteristics
    - ➢Using male college graduates as subjects
      - Will control for potential confounding effects of gender and education
  - **Statistical control**: anticipating, measuring, and statistically controlling for confounding variables' effects
    - ➢i.e., hold them statistically constant, or statistically removing their effects

Function of Effective Research Design

- Effective research design is a function of
  - Adequate (full range of) variability in values of research variables,
  - Precise and accurate measurement,
  - Identifying and controlling the effects of confounding variables, and
  - Appropriate subject selection

4) Types of Research Design

Types of Research Design

- There are several types of research design:
  - Experimental design
  - Non-experimental design
  - Qualitative design
  - Quantitative design

An Example of Research Design

Objective	Type of data	Source of data	Method of data collection	Method of data analysis
Assess farmers' knowledge of key recommendations	Knowledge on: ►Maize varieties ►Plant spacing	120 growers: ►60 women ►60 men	Oral test	Descriptive statistics using SPSS
Assess farmers' application of key recommendations.	Farmer practice on: ►Varieties grown ►Plant spacing used	120 growers: ►60 women ►60 men	Observation & measurement	Descriptive statistics using SPSS
Identify factors affecting application of recommendations.	Reasons for following & not following recommendations on ►Varieties ►Plant spacing	120 growers: ►60 women ►60 men	Discussion with individual farmers	Content analysis & descriptive statistics

Selection of Research Design

- It is depending on:
  - Nature of the research problem
  - Purpose of the study (ex. description, exploration, etc.)
  - Researcher’s knowledge & experiences
  - Researcher’s interest and motivation
  - Resource available (cost, time, human, equipment)
  - Subjects/participants (number & availability)
  - Research ethics & principle (legal principle)
  - Users of the study findings
  - Possible control on extraneous variables (maximize result, decrease errors)

References

[1] Kothari, Chakravanti Rajagopalachari. Research methodology: Methods and techniques. New Age International, 2004, (Second Revised Edition).

[2] Kerlinger, Fred N., 1986, Foundations of Behavioral Research (3rd edition), New York, Holt, Rinehart and Winston.

[3] Amanda, J. R, 2013, Quantitative research design

[4] Ajyesh Patidar, Research approaches and design