Research Approaches – Quantitative Approach

Research Methods vs Research Design

- Both research methods as well as research design are crucial for successful completion of any research project.
- Research methods are loose framework or guidelines from which one has to select one and then apply a research design on that method to achieve desired results.
- Research design – the specific plan for data collection, measurement and analysis, approaches in selecting techniques
Research approaches/methods

3 research approaches/methods

- Qualitative
  - **Quantitative** - to develop and employ mathematical models, theories and hypotheses pertaining to natural phenomena.
    - Measuring is key in quantitative research because it shows the relationship between data and observation

- Mixed-Method – Quali + Quanti

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Definitions of Quantitative and Qualitative Research

<table>
<thead>
<tr>
<th><strong>Quantitative Research</strong></th>
<th><strong>Qualitative Research</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>A type research in which the researcher:</td>
<td>A type of research in which the researcher:</td>
</tr>
<tr>
<td>- decides what to study;</td>
<td>- relies on the views of participants;</td>
</tr>
<tr>
<td>- asks specific, narrow questions;</td>
<td>- asks broad, general questions;</td>
</tr>
<tr>
<td>- collects quantifiable data from participants;</td>
<td>- collects data consisting largely of words (or text) from participants;</td>
</tr>
<tr>
<td>- analyzes these numbers using statistics;</td>
<td>- describes and analyzes these words for themes;</td>
</tr>
<tr>
<td>- and conducts the inquiry in an unbiased, objective manner.</td>
<td>- conducts the inquiry in a subjective, biased manner.</td>
</tr>
</tbody>
</table>
Quantitative vs Qualitative

<table>
<thead>
<tr>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positivist approach - inductive</td>
<td>Naturalist approach - deductive</td>
</tr>
<tr>
<td>Specific, well structured</td>
<td>Less specific and less structured</td>
</tr>
<tr>
<td>Study design and method for data collection are clear</td>
<td>Over lap in study design and method for data collection. Example in-depth interview is a study design and also method for data collection</td>
</tr>
<tr>
<td>Study can be easily replicated and retested for verification</td>
<td>Study cannot be easily replicated and retested for verification</td>
</tr>
</tbody>
</table>

Research Process of Quantitative vs Qualitative Approaches
Quantitative research design – based on the nature of investigation

- Experimental design
- Non-experimental
  - Correlation design
  - Survey design

Experimental design

- Research in which the investigator deliberately controls and manipulates the independent variable to observe the effect of that change on another the dependent variable.
- To establish the existence of cause and effect relationship between two variables.
- The simplest experimental design
  - Randomly selects subjects from population
  - Experimental group—receives treatment
  - Control group—does not receive treatment
- The study can be undertaken as cross-sectional, before and after study or longitudinal study.
When to Use Experimental Procedures

- Used to establish cause and effect
  - Between independent and dependent variables
  - Control for all variables that might influence the outcome
- Used when comparing two or more groups
- Example: study the effect of new teaching strategy on student achievement.

Characteristics of Experimental Designs

- Random assignment – assign individual to random groups
- Control over extraneous variables that might influence the relationship– Influences in participant selection, procedures, statistics, or the design likely to affect the outcome
- Manipulation of the treatment conditions – manipulate the independent variables to determine the effect on the outcome
- Outcome measures – assess whether the treatment conditions influence an outcome (dependent variable)
- Group comparisons – compare scores for different treatment
- Guard against threats to validity – guard against false conclusion
The Experimental Manipulation of a Treatment Group

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Dependent variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age (cannot manipulate)</td>
<td>Frequency of smoking</td>
</tr>
<tr>
<td>2. Gender (cannot manipulate)</td>
<td></td>
</tr>
<tr>
<td>3. Types of instruction (can manipulate)</td>
<td></td>
</tr>
<tr>
<td>a. Lecture (control)</td>
<td></td>
</tr>
<tr>
<td>b. Lecture + hazard instruction (comparison)</td>
<td></td>
</tr>
<tr>
<td>c. Lecture + hazard instruction + slides of damaged lungs (experiment)</td>
<td></td>
</tr>
</tbody>
</table>

Types of Experiments: Between Groups

- True experiments – Controlled setting
  - Pre- and posttest
  - Posttest only
- Quasi-experiments – Natural setting
  - Pose more threat to internal validity than true experiment
  - Pretest and Posttest
  - Factorial designs – different treatment to different groups
EXPERIMENTAL DESIGNS

<table>
<thead>
<tr>
<th></th>
<th>True Experimental Design</th>
<th>Quasi-Experimental Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of a control group?</td>
<td>Always</td>
<td>Often</td>
</tr>
<tr>
<td>Random selection of subjects from a population?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Random assignment of subjects to groups?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Random assignment of treatments to groups?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Degree of control over extraneous variables?</td>
<td>Yes</td>
<td>Some</td>
</tr>
</tbody>
</table>

TRUE EXPERIMENTAL DESIGNS

- **Characteristics**
  - Random assignment
  - Control group
- **Three typical designs**
  - Pretest post-test control group design
  - Post-test only control group design
  - Solomon four-group design
## PRETEST POST-TEST CONTROL GROUP DESIGN

<table>
<thead>
<tr>
<th>Random Assignment of Participants to Control Group</th>
<th>Pretest</th>
<th>No Treatment</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Assignment of Participants to Experimental or Treatment Group</td>
<td>Pretest</td>
<td>Treatment</td>
<td>Post-test</td>
</tr>
</tbody>
</table>

- Groups should be equivalent at beginning
- Observed differences must result from treatment

## POST-TEST ONLY CONTROL GROUP DESIGN

<table>
<thead>
<tr>
<th>Random Assignment of Participants to Control Group</th>
<th>No Treatment</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Assignment of Participants to Experimental or Treatment Group</td>
<td>Treatment</td>
<td>Post-test</td>
</tr>
</tbody>
</table>

- **Use when**
  - Sample is sufficient (≥ 30/group)
  - Pre-testing is not possible
- **Disadvantages**
  - If randomization is not effective, groups may not be equivalent
  - Cannot use pretest to assign to groups
SOLOMON FOUR-GROUP DESIGN

<table>
<thead>
<tr>
<th>Assignment to</th>
<th>Pretest</th>
<th>Treatment</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Random</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Random</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Random</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group 3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Many different comparisons are possible

Types of Experiments: Within-Group

- Time series experiments
  - Interrupted
  - Uninterrupted
- Repeated measures experiments
- Single-subject experiments
  - A/B design
  - Multiple baseline design
  - Alternating treatments
Steps in Conducting Experimental Research

1. Decide if an experimental design fits research problem
2. Form cause/effect hypotheses
3. Select experimental unit and identify study participants
4. Select an experimental treatment and introduce it
5. Choose a type of experimental design
6. Conduct the experiment
7. Organize and analyze the data
8. Develop an experimental research report

Correlation design

- In **correlational research designs**, researcher use the correlation statistical test to describe and measure the degree of association (or relationship) between two or more variables or sets of scores
- Statistic that expresses linear relationships is the product-moment correlation coefficient – bivariate correlation
- Example: Study the relationship between student self-efficacy and academic achievement
- Do not imply a cause-and-effect relationship
- Do imply that variables share something in common
When to Use Correlational Designs

- To examine the relationship between two or more variables
- To predict an outcome:
  - Look at how the variables co-vary together
  - Use one variable to predict the score on another variable
- Forms of Data collection is similar to survey design
- Can be conducted cross-sectional, before and after or longitudinal

Types of Correlational Design
- Explanatory
- Prediction

Types of Correlational Designs: Explanatory Design

- Correlate two or more variables
- Collect data at one point in time
- Analyze all participants as a single group
- Obtain at least two scores for each individual in the group—one for each variable
- Report the correlation statistic – Pearson Product Moment Correlation
- Interpretation based on statistical test results indicate that the changes in one variable are reflected in changes in the other
Types of Correlational Designs: Prediction Designs

- Predictor variable: A variable that is used to make a forecast about an outcome in the correlational study
- Criterion variable: The outcome being predicted
- “Prediction” usually used in the title
- Predictor variables usually measured at one point in time; the criterion variable measured at a later point in time
- Purpose is to forecast future performance
- Statistics used: Simple/Multiple Linear Regression

Conducting a Correlational Study

- Determine if a correlational study best addresses the research problem
- Identify the individuals in the study
- Identify two or more measures for each individual in the study
- Collect data and monitor potential threats
- Analyze the data and represent the results
- Interpret the results
CORRELATION COEFFICIENT

- Expresses degree of linear relatedness between two variables
- Varies between −1.00 and +1.00
- Strength of relationship is
  - Indicated by absolute value of coefficient
  - Stronger as shared variance increases

TWO TYPES OF CORRELATION

<table>
<thead>
<tr>
<th>If X…</th>
<th>And Y…</th>
<th>The correlation is</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increases in value</td>
<td>Increases in value</td>
<td>Positive or direct</td>
<td>The taller one gets (X), the more one weighs (Y).</td>
</tr>
<tr>
<td>Decreases in value</td>
<td>Decreases in value</td>
<td>Positive or direct</td>
<td>The fewer mistakes one makes (X), the fewer hours of remedial work (Y) one participates in.</td>
</tr>
<tr>
<td>Increases in value</td>
<td>Decreases in value</td>
<td>Negative or inverse</td>
<td>The better one behaves (X), the fewer in-class suspensions (Y) one has.</td>
</tr>
<tr>
<td>Decreases in value</td>
<td>Increases in value</td>
<td>Negative or inverse</td>
<td>The less time one spends studying (X), the more errors one makes on the test (Y).</td>
</tr>
</tbody>
</table>
WHAT CORRELATION COEFFICIENTS LOOK LIKE

- Pearson product moment correlation
  - $r_{xy}$
  - Correlation between variables $x$ and $y$
- Scattergram representation
  1. Set up $x$ and $y$ axes
  2. Represent one variable on $x$ axis and one on $y$ axis
  3. Plot each pair of $x$ and $y$ coordinates

- When points are closer to a straight line, the correlation becomes stronger
- As slope of line approaches 45°, correlation becomes stronger
Survey design

- Survey research designs – researcher administer a survey to a sample or to the entire population of people in order to describe the attitudes, opinions, behaviors, or characteristics of the population.
- Seeks to describe trends in a large population of individuals
  - Does not explain cause and effect
  - May examine correlation between variables (like correlational design).
- Used to:
  - To assess trends – ‘Rukun Tetangga’ trend among housing estates
  - To assess opinions, beliefs, and attitudes – opinion about 1Malaysia concept
  - For follow-up analyses – graduate tracer study
  - For evaluations – evaluate the success of teaching Science & Math in English

Types of survey design

- **Study over time**
  - Longitudinal
    - Trends in the same population over time
    - Changes in a subpopulation identified by a common characteristic over time
    - Trend
    - Cohort
    - Panel
- **Study at one point in time**
  - Cross-sectional
    - Changes in the same people over time
    - Group composition
    - Community needs
    - National assessment
    - Program evaluation
Key Characteristics of Survey Research

- Sampling from a population
- Collecting data through questionnaires
- Designing instruments for data collection
- Obtaining a high response rate

Forms of Data Collection

Who completes or records the Data?

- Participant
  - Mailed questionnaire
  - Group administered questionnaire
- Researcher
  - Electronic questionnaire
  - Drop & collect questionnaire

One on one
  - Individual interview
  - Focus group interview
To a group
  - Telephone interview
  - Over telephone

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Steps in Conducting Survey Research

1. Decide if a survey is the best design to use
2. Identify the research questions or hypotheses
3. Identify the population, the sampling frame, and the sample
4. Determine the survey design and data collection procedures
5. Develop or locate an instrument
6. Administer the instrument
7. Analyze the data to address the research questions or hypotheses
8. Write the report

Population, Target Population, Sampling Frame, and Sample

The Population
The group of individuals having one characteristic that distinguishes them from other groups.

The Target Population or Sampling Frame
The actual list of sampling units from which the sample is selected.

The Sample
The group of participants in a study selected from the target population from which the researcher generalizes to the target population.

Cross Sectional vs. Longitudinal Study

- **Cross Sectional** – one shot study. Decide what to study, select sample, contact respondent and get the information. Cannot measure change overtime.
- **Longitudinal research** – study individuals over time using repeated measurement. Study the pattern of change
  - Study child development overtime
  - Study deterioration in mental ability among adults over time

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Qualitative design

- Case study
- Oral history
- Focus group interview
- Participant observation
- Reflective journal log
- Ethnography
Case study
- Select a individual/individuals or situations and study them through interview or observation.
- Example: Study individual suffering from HIV – how do they cope through spiritual perspective

Oral history
- Study perceptions, experiences and accounts of an event.
- Example: Study the cruelty of the communist from those who suffered or tortured by the communist

Focus group interview
- Explore attitude, opinion or perception towards an issue, product, service or program through a free and open discussion between members of group.
- Researcher asks question and members responds to them

Participant observation
- Researcher get involve in the activity of the group, create a rapport with the group, then keenly observe the situation of study.
- Example: Study ethnic relations in Gotong-Royong Activity.
Reflective journal log
- Researcher writes a log of his thoughts whenever he notices anything, talk to someone, participate in an activity or observe a situation

Ethnography
- Researcher study an intact cultural group in a natural setting over a prolonged period of time by collecting observational data

Summary
- Research methods vs research design
- Quantitative vs Qualitative
  - Quantitative design:
    - Experimental
    - Non-experimental
      - Correlational & survey
    - Can be done cross-sectional or longitudinal
- Qualitative design
  - Interview
  - Observation
  - Journal