

WOX7001 – RESEARCH METHODOLOGY

Topic 1 - Introduction to academic research

Agenda

01

RESEARCH -
BACKGROUND

02

RESEARCH
SIGNIFICANCE

03

SAMPLE
RESEARCH

04

RESEARCH
CATEGORIES

05

CLASS
ACTIVITIES

What is research

The word research is derived from the Middle French "recherche", which means "to go about seeking", the term itself being derived from the Old French term "recerchier" a compound word from "re-" + "cerchier", or "sercher", meaning 'search'. The earliest recorded use of the term was in 1577.

[Wikipedia](#)

"act of searching closely" for a specific person or thing, from French *recherche* (1530s, Modern French *recherche*), back-formation from Old French *rechercher* "seek out, search closely"

[Online Etymology Dictionary](#)

So, the main act of research is searching

Prepared by: HSM, FAC and SUTI

So, in simple term research is...

To find answers about something that we are not sure of.

Whether is about a phenomenon which has happened, that is happening or has not happened, we can carry out studies or research to find the answers.

i.e. research is carried out to find out a valid answer (research results) to a problem (uncertainty).

And also,

A research is conducted using systematic methods to ensure that the information obtained is reasonable and is supported by quantitative or qualitative data.

Why we need to search?

The common questions when we search:

How significance is my research?

How it going to contribute to the community and society?

How it going to improve the current body of knowledge or
going to create new knowledge?

How to search?

Obtain knowledge which is valid and reliable (i.e. knowledge with scientific and logical foundations)

Collect evidence in order to give an answer to any doubt or problem which arises
Correct any stereotyping, traditions and belief which are untrue

Predict the existence of a phenomenon

Explain the truth about a phenomenon.

But then why we are calling it research, instead we are only searching??

Research is repeated searching (i.e. *re*-search).

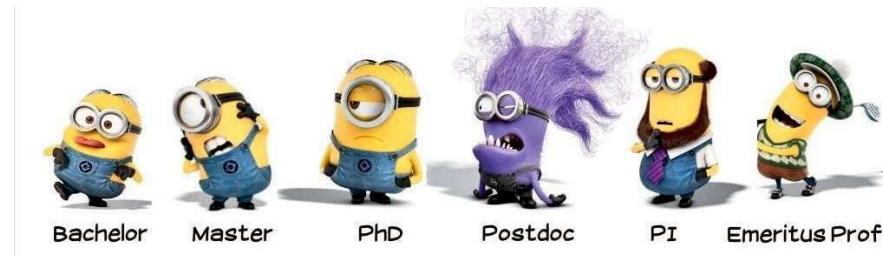
i.e. the process of searching through what other people may have searched with the aim of uncovering what is yet to be discovered.

It may require interpreting what had been found in a new but innovative way.

Originality is a key term in research

involves thinking about things in a way that other people have not reached a conclusion that is unique.

Comparison between Masters and PhD. Research



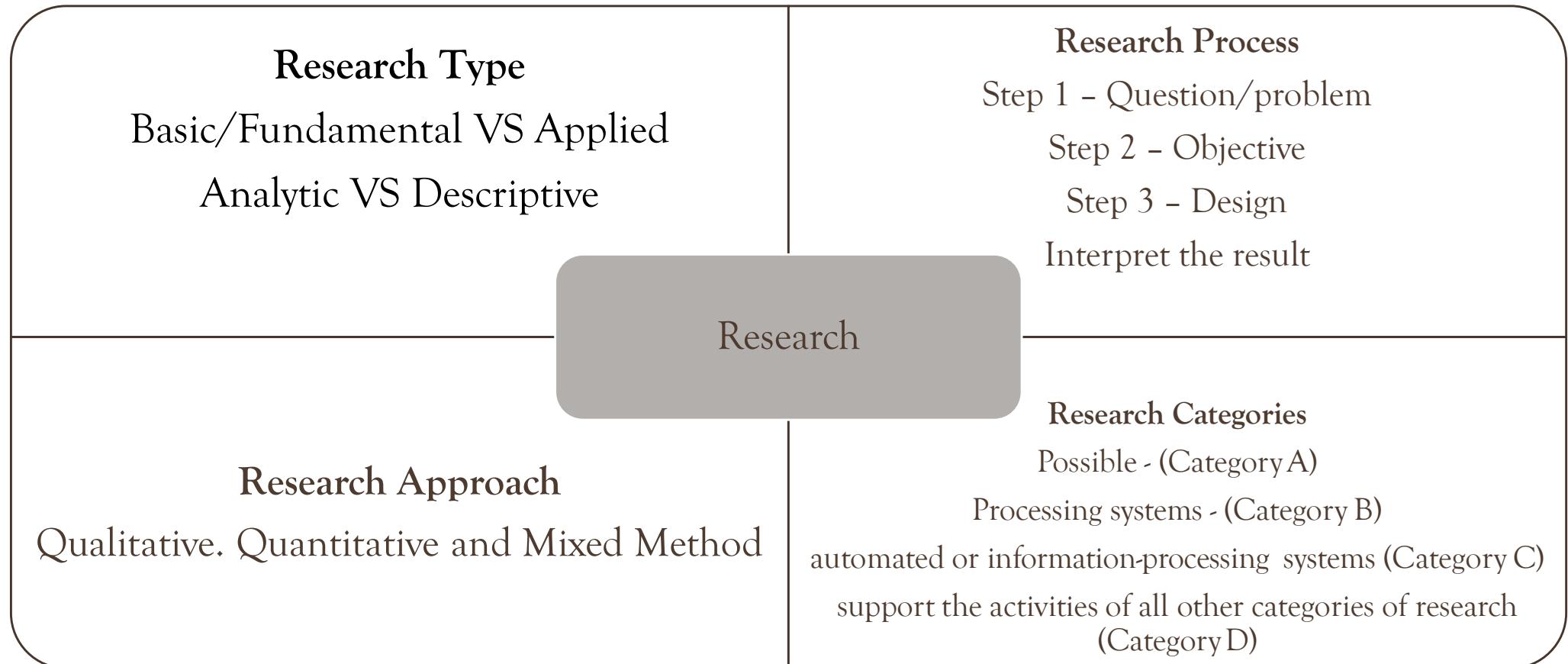
Masters

- To solve a problem using the methodology that you have learned

PhD

- Using the methodology that you have learned and experience of solving problem to produce something new

Academic Research



Research Type

Prepared by: HSM, NAG and SUH

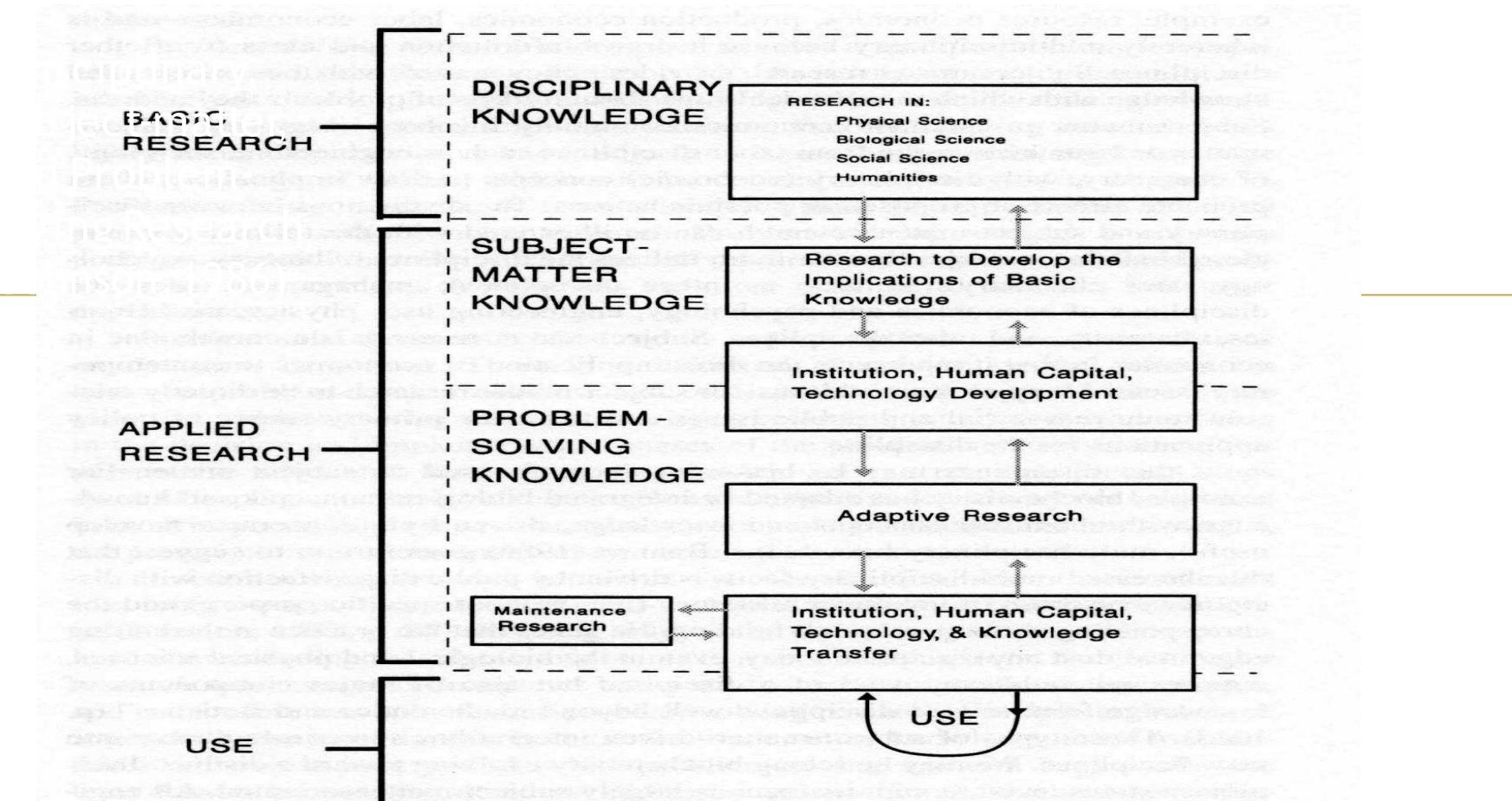


Figure 2.1. Relationship among research, knowledge, and use (Bonnen, 1986).

Research Type – Basic vs Applied Research

- Basic – to determine or establish fundamental facts and relationships within a discipline or field of study.
- Applied – undertaken specifically for the purpose of obtaining information to help resolve a particular problem

Basic Research - Disciplinary

- designed to improve a discipline
- dwells on theories, fundamental relationships and analytical procedures and techniques
- It is synergistic and complementary with subject matter and problem-solving research
- Provides the foundations for applied research

Applied Research - Subject-matter research

- “research on a subject of interest to a set of decision makers”
- Tends to follow subject-matter boundaries within a discipline
- Inherently multidisciplinary, drawing information from many disciplines
- prediction model-- can u name few prediction model. So those prediction model is a design solution of something. And u will use those prediction model to resolve a problem. Then it is an applied research

Applied Research – Problem Solving Research

- Designed to solve a specific problem for a specific decision maker
- Often results in recommendations on decisions or actions
- Problem-solving research is holistic – uses all information relevant to the specific problem

Research Type – Analytic vs Descriptive Research

- Descriptive Research - the attempt to determine, describe, or identify something
 - The intent is often synthesis, which pulls knowledge or information together
- Analytic - the attempt to establish why something occurs or how it came to be

Research Process

Prepared by: HSM, NAG and SUH

Research Process



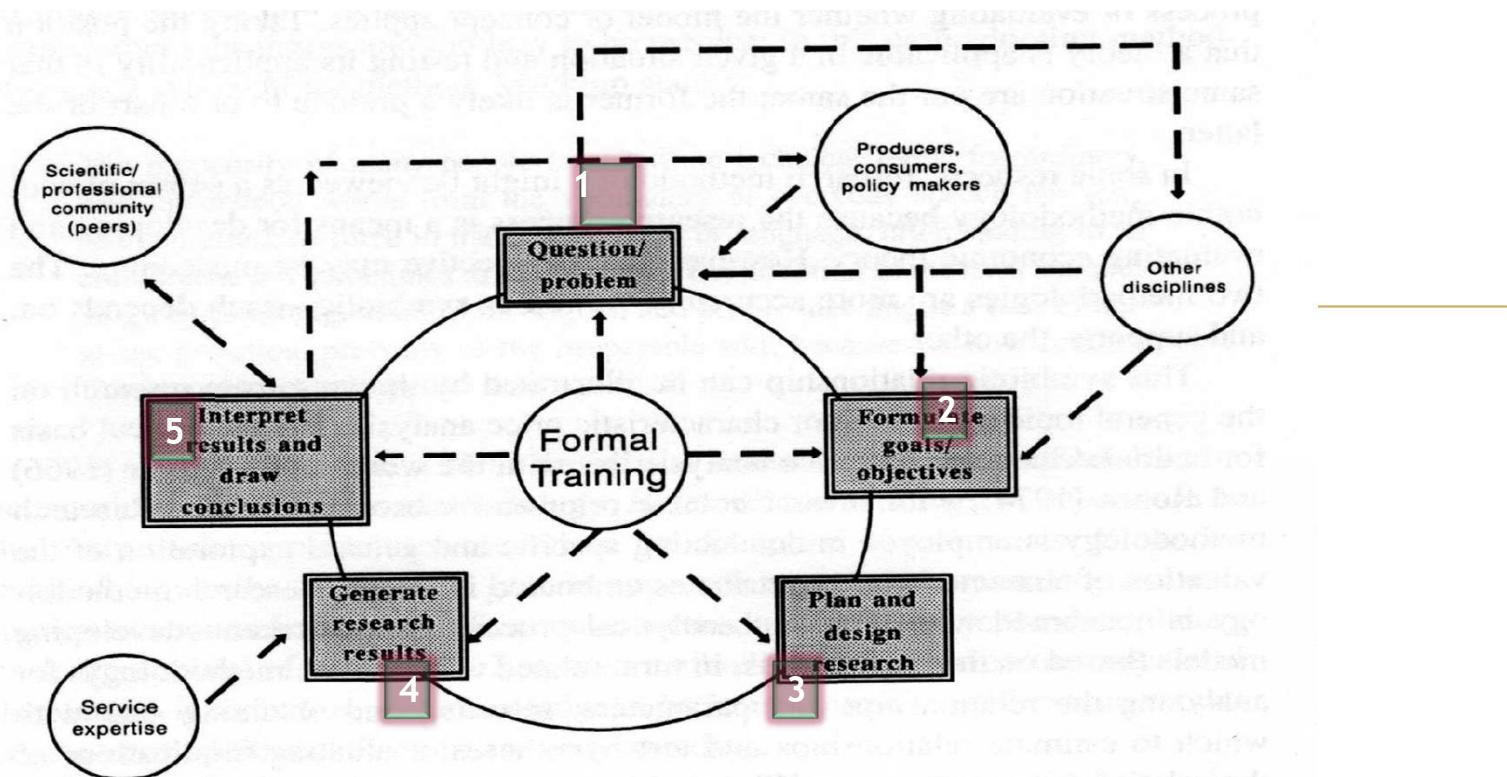


Figure 2.2. Schematic of research process.

Research Approach

Prepared by: HSM, NAG and SUH

Research Approach

- Plans and procedures for research that span the steps from broad assumptions and detailed methods of data collection, analysis and interpretation.
- The selection of a research approach is also based on the nature of the research problem or issue being addressed, the researchers' personal experiences, and the audiences for the study.

Research Approach

Qualitative

- approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem.
- The process of research involves emerging questions and procedures, data typically collected in the participant's setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data.

Quantitative

- approach for testing objective theories by examining the relationship among variables.
- These variables, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures

Mixed Methods

- approach to inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks.
- The core assumption of this form of inquiry is that the combination of qualitative and quantitative approaches provides a more complete understanding of a research problem than either approach alone.

Research in Computer Science

Prepared by: HSM, NAG and SUH

Research in Computer Science

The fundamental knowledge underlying computing research is from philosophy and Mathematics.

constrained by reasoning and formalised in logic - philosophical research.

analytic in nature and constrained by theoretically provable propositions and axioms - mathematical research.

CS research derives its power of expression from mathematics, particularly discrete mathematics.

Is constrained by what is theoretically computable.

What CS are searching for? (sample)

Computer Scientist can study different data structures (e.g. list, linked list, queue, tree, and array) to know why they perform differently in different environments (e.g. small and large database environments).

He may then go further to propose various algorithms for implementing these data structures as well as those required for manipulating them (e.g. search, sort)

In the process, some parameters that specify the performance of each algorithm may be provided.

What CS are searching for? (sample)

Another e.g., in the development of Artificial Neural Networks (ANN), computer scientists study the behaviours of human neurons as described in the biological sciences.

Using this knowledge, the CS researchers produced computational models with varying configuration as structures.

The aim in proposing these models is not for solving any practical problems but to investigate all possible problem scenarios in abstract term.

Research in Data Science

Prepared by: HSM, NAG and SUH

Research in Data Science

Data Science is a multi-disciplinary field that capitalizes on theories, methods, techniques, and algorithms from information technology (ICT), including visualization and machine learning.

Data Science builds upon a foundation of theories from computer science, mathematics (in particular statistics), and social sciences, etc., to enable a large variety of applications, including predictive analytics and business intelligence, data-driven sciences (big data science), and artificial intelligence.

What DS are searching for? (sample)

Data scientist can study 8v's of big Data (e.g. velocity, volume, visualization and etc) to know why they perform differently in different environments (e.g. small and large database environments).

He may then go further to propose various algorithms for implementing these architectures as well as those required for manipulating them.

What DS are searching for? (sample)

Another e.g., in the reducing the cost of complex analytics in the cloud

data scientists study the different machine learning algorithms

Using this knowledge, the DS researchers produced non-complex analytics models with varying library usage.

Research in Cyber Security

Prepared by: HSM, NAG and SUH

Research in Cyber Security

Cybersecurity is concerned with making **cyberspace safe** from threats, namely cyber threats. Is an important tool in protecting and preventing unauthorized surveillance.



technical and non-technical, intended to protect computers, computer networks, related hardware and devices software, and the information they contain and communicate, including software and data, Other elements of cyberspace, from all threats, including threats to the national security



The degree of protection resulting from the application of these activities and measures



The associated field of professional endeavor, including research and analysis, aimed at implementing and those activities and improving their quality

What Cybersecurity are searching for? (sample)

The cyber security research initiative is an attempt that is required to enable the country to get ahead of adversaries and produce the technologies.

These futuristic technologies can protect information systems and networks.

The initiative is a platform to work together to foster R&D to evolve transformative solutions and address critical cyber security challenges, through partnerships among academics, Industry and Govt.

Prepared by: FCSM, FACC and SCIT

Why research is important in Cyber Security

Research is needed to ensure information sharing mechanisms for cybersecurity breaches and vulnerabilities remain effective and continue to improve.

Research and innovation in cyber-physical system development should be further prioritised to mitigate the substantial risks these systems introduce

Research Categories

Category A

Study of or exploring on what is possible

Category B

Study of real-world phenomena or existing naturally occurring information-processing systems

Category C

Research involving creation of new useful automated or information-processing systems

Category D

Research related to creation and evaluation of tools, formalisms and techniques to support the activities of all other categories of research

Category E

Research related to social and economic impact issues of development in computing technology

Research Categories – Category A

CS

Mathematical theory Related to work on Theorems relating to limits of computation Complexity

properties of mechanisms for cryptography

Study behavioural properties of different types of mechanisms/architectures/systems

DS

Computational theory Related to work on machine learning to limits of computation Complexity

properties of mechanisms for library

Study behavioral properties of different types of data science architectures

Research Categories – Category B

CS

Study of different forms of computation allows us to find new ways of formulating and testing powerful models and theories for explaining and predicting natural phenomena.

To model and explain aspects of human-intelligence

Relevant to work on:

Analysis and simulation of human engineering activities

AI or cognitive science on simulation of human design processes

DS

Study different machine learning algorithms performance allow us to find new ways of formulating and testing machine learning models.

To model and explain aspects of Weather patterns

Assessing the effects of fuel energy consumption, foreign direct investment and GDP on CO₂ emission: New data science evidence from Europe & Central Asia

Research Categories – Category C

CS

The goal is to create new practically useful systems that add to the body of knowledge

Research closely related to production, analysis and evaluation of practical applications

- Proving mathematical theorems, doing numerical computations
- Translating from one language to another
- Design new machines

DS

The goal is to create new practically useful data science systems that add to the body of knowledge

Research closely related to production, analysis and evaluation of practical applications such as:

- Weather forecast, face recognition
- Generate code from requirement specifications by via natural language processing

Research Categories – Category D

CS

Work involving processes of performing the activities/tasks in the previous categories.

- Automatic program synthesizers, code generators from a complex analysis model, creation of analysis and design methods and tools
- Tools to support exploratory design of software (e.g. most AI development environments)

DS

Research related to creation and evaluation of tools, formalisms and techniques/methods to support the various activities of research.

- Tools to measure the prediction accuracy of various machine learning models
- Tools to measure the Feature Binning which related to feature engineering.

Research Categories – Category E

CS

- Research related to the study of
 - social and economic impact of computing
 - ways in which developments in computing technology have influenced social, educational, economic, legal and political processes and structures.
 - Analysis of ethical implication of impact of the new technology in jobs, opportunities, power structures, resources, etc for various social groups

DS

- Research related to the study of
 - social and economic impact of data science
 - ways in which developments in data science technology have influenced social, educational, economic, legal and political processes and structures.
- Eg: Analysis of ethical implications of processing social media data. in the perspective of security of the information provided in the social media.

Class Activity

Estimated time - 1 hour

Q1: In your opinion what are the possible research that could be conducted in the following domains (choose only one). And propose possible research according to each category (Category A, B, C, D and E).

- a) Agriculture
 - b) Environmental
 - c) Mental Health
2. Why there is a need to conduct those research? How it going to contribute to the society?

It is a group task (5 in a group) and every group need to present your discussion outcome at the end of 30 min.

THANK YOU

WOX7001 - RESEARCH METHODOLOGY

Topic 2 - Research Problem, Research Objective,
Research Questions, Scope, Contribution

Agenda

01

RESEARCH
PROBLEM

02

RESEARCH
QUESTION

03

RESEARCH
OBJECTIVE

04

RESEARCH
SCOPE
RESEARCH
CONTRIBUTION

05

CLASS
ACTIVITIES

Research Problem



What is research problem?

- ❖ A research problem is a question that researcher wants to answer or a problem that a researcher wants to solve.
- ❖ Identification & formulation of a research problem is the first step of the research process.
- ❖ Selection of research problem depends on several factors such as researcher's knowledge, skills, interest, expertise, motivation & creativity with respect to the subject of inquiry.
- ❖ It is like the identification of a destination before under taking a journey.
- ❖ Without a problem, research cannot proceed because there is nothing to proceed to ward.

Research Problem Concepts

Problem situation	The context that has called a researcher's attention within the topic
Research problem	What a researcher thinks needs to be studied within the problem situation
Problem statement	Specific description of what intrigues a researcher. Generally speaking, it includes briefly what it is already known about the problem situation and that establishes the context from which the research problem emerges, what is unknown and deserves to be studied – the research problem- and why it is important to know about that problem
Purpose statement	What a researcher intends to find out or do in a study
Research question	What a researcher specifically wants to answer – or test- conducting a study

Research Problem is NOT....

A solution

A question

A title

An opinion or speculation

Instead, Research Problem IS....

- A situation that is broken
- Shows cause and effect relationship(s)
- A short and precise sentence
- Based on initial observations and evidence

Not all problem is a RP

- While problem to you might bother you; it might not qualify as research problem.
- If my company goes bankrupt, then this is my problem, but it is not a problem as such.
- So the situation is a problem to me, but it is not a research problem as nothing is broken in that situation

Example of RP

The organization is showing a high fluctuation rate as the leadership team is *lacking people management skills.*

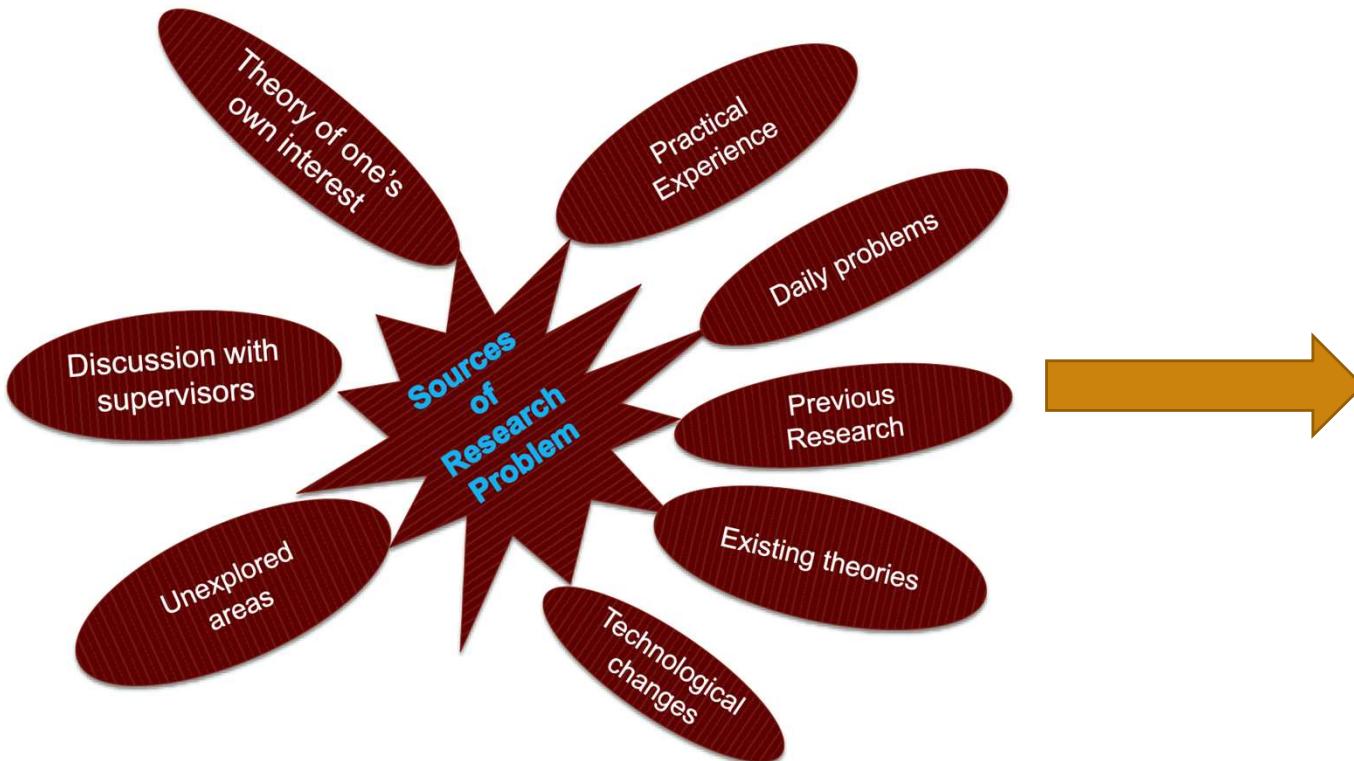
The above example of research problem:

- *is broken*
- a cause and effect relationship is in place, and they are short and precise; and
- initial observations and evidences are mentioned.

Points to Consider while choosing the RP

- The subject on which research work has been overdue should not be chosen, because it will be a difficult task to throw any new light.
- The problem should neither be too narrow nor too vague.
- The topic of the research should be familiar and feasible so that the researcher can easily have an access to related research materials or source of research.
- Controversial subject should be avoided
- importance of subject, the qualifications , the training of researcher , the investment elements in the research in terms of time, money and energy.

How to get the RP??



RP Format

Declarative Format

- a research problem is stated in declarative statement.
- Factors of Covid-19 infection

Interrogative Format

- In interrogative format, a research problem is stated in question form.
- e.g- “What is the Factors of covid-19 infection among childrens?”

How to write PS

- “The problem P . . .”: Here insert the problem as defined by the company.
- “. . . has the impact I .” Insert the negative impacts/pain points of the problem.
- “. . . which affects B . . .” Insert the parties that are affected. IT could be the business, the customers or a third party.

Samples

1.3 Problem statement

The Internet of Things (IoT) generates a massive volume of traffic from heterogeneous networks such as smart healthcare, smart grid, etc. One of the issues in existing routing schemes based on shortest paths and techniques like MPLS cannot manage the real-time data generated from devices especially for satisfying the multi-constrained Quality of Service (QoS) such as delay, packet loss, and jitter (Han et al., 2018). The literature has focused on utilizing a single QoS metric individually and there can be applications that need to satisfy multiple QoS metrics. Thus, there still exists a research gap on satisfying multi-constrained QoS metrics in the smart healthcare systems using the SDN approach.

Another Samples

1.3 Problem Statement

Laboratory experimental practice is an important teaching concern nowadays. Ironically, a class full of students do not allow to conduct laboratory exercises individually by each student, due to the minimal resources and time according to the traditional procedure. Not only in such situation but also, the pandemic like covid-19 has enforced and proven that doing lab work under a remote robotic laboratory platform can be an effective solution and can further bring massive evolution to the education system. In this research, to overcome the considered situations, an online framework for real-time lab exercise remotely has been developed. To evaluate the developed system a survey was conducted on students of mechanical engineering who have used the remote robotic laboratory facility.

One more sample

4 PROBLEM STATEMENT

Even though many of the researches come-up with many approaches to minimize the DoS attack on the SIP-VoIP architecture. But still there is lot of DoS attack being conducted against architecture every day. This is because basically SIP protocol is a test base and involves a simple connection process and easy to implement. In that case it is difficult to find false signal performing in running services.

DoS attacks used against the target to make the SIP-VOIP network unavailable so that legal user should not have access to the services. This way attacker can gain many of the advantages including monetary value.

Research Question

Prepared by: HSM, NAG and SUH

Research answers questions - but what kinds of questions - and where do the questions come from?

- Understanding the reality – How is world is -what is happening –Positive questions?
- Understanding how you want world to look like – Normative questions?
- Research is well suited for answering positive questions.
- Research does not help much in answering normative questions.

RQ

The research question defines the “area of interest” but it is not a declarative statement like a hypothesis

Research question :main broad questions - general focus

Research question may be complemented by a few investigative questions :
secondary/sub questions-specific : to narrow the focus-important for data measurement.

A clear research statement or problem must translate into a research question.

Research question to be fact-oriented, information-gathering question.

Research question must be capable of being confirmed or refuted.

RQ - Example

Research Topic : An International comparison of Technology Adoption Testing the UTAUT Model

RQ1 How does acceptance of a technology vary across cultures?

RQ2 What factors in the UTAUT model most significantly differ across cultures and what are the implications of these differences?

Research Objective

Prepared by: HSM, NAG and SUH

We have asked the question, how to answer it???

- ‘A research objective is a clear, concise, declarative statement, which provides direction to investigate the variables.’
- Generally research objective focuses on the ways to measure the variables, such as to identify or describe them.
- Sometime objectives are directed towards identifying the relationship or difference between two variables.

RO

- Having decided what to study (Research Topic), and knowing why you want to study it (Problem Statement), you can now formulate the study objectives.
- Objectives should be closely related to the statement of the problem. For example, if the problem identified is low utilization of health stations in a rural district, the general objective of the study could be to assess the reasons for this low utilization.
- If we break down this general objective into smaller and logically connected parts, then we get specific objectives.

RO

Research objectives are the specific actions/ activities to answer the research questions.

Objectives indicate what we are trying to get from the study or the expected results / outcome of the study.

How to Make RO look SMART..

S

Specific

State what you'll do
Use action words

M

Measurable

Provide a way to evaluate
Use metrics or data targets

A

Achievable

Within your scope
Possible to accomplish, attainable

R

Relevant

Makes sense within your job function
Improves the business in some way

T

Time-bound

State when you'll get it done
Be specific on date or timeframe

Types of RO (General VS Specific)

- Specific objectives are short term & narrow in focus.
- General objectives can be broken into small logically connected parts to form specific objectives.
- General objective is met through accomplishing all the specific objectives.
- The specific objectives are more in number & they systematically address various aspects of problem as defined under ‘the statement of problem’ & key factor that is assumed to influence or cause the problem.
- They should specify what the researcher will do in the study, where, & for what purpose.

Things needed to write RO

- Use action verbs that are specific enough to be measured (to determine, to compare, to verify, to calculate, to describe, to find out, to establish etc.)
- Avoid the use of vague non-action verbs such as to appreciate, to understand, to study, to believe
- Objectives may be specified in the form of actions (verbs) to answer the posed questions- generally objectives begin with to : discover ..., determine ..., establish ...access....., identify....., compare, analyze, evaluate....., ...etc.

RQ and RO

RQ

- 1.What are the factors that the most lead to the teacher stress?
- 2.What is the relationship between level of stress and categories of health problem?
- 3.How does stress affect the job performance among teachers?

RO

- . To identify the factor that lead to the stress among teachers.
- 2.To determine the relationship between stress and health problem
- 3.To explore the effect of stress in job performance among teachers.

Sample - RO

1.4 Research Questions

1. Is it feasible to implement AR in public service advertisements?
2. Which AR SDK can provide the best performance of marker identification and tracking in designing public service advertisements?

1.5 Research Objectives

Following research objectives would facilitate the achievement of this aim:

1. To conduct a feasibility analysis for AR-based public service advertisements.
2. To compare/investigate the marker identification and tracking performance of AR SDKs in designing public service advertisements.
3. Evaluate the result of the investigation of the resulting SDK.

Sample - RO

3. RESEARCH QUESTIONS

1. What are the security and privacy issues affecting the IoT-based networks?
2. What are the security and privacy issues affecting the Edge computing paradigm?
3. What are the limitations of the existing authentication and key agreement (AKA) techniques deployed to IoT-based networks?
4. How can we solve the identified issues using a proposed lightweight authentication and key agreement technique to provide secure communication in the IoT-based networks?
5. How can we incorporate a mechanism for dynamic addition of network entities after the initial deployment for ensuring scalability?
6. How can we analyze and test the security and lightweight features of the proposed technique using the available parameter metric functions?
7. How can we compare and evaluate the performance of the proposed technique against the existing benchmarking schemes?

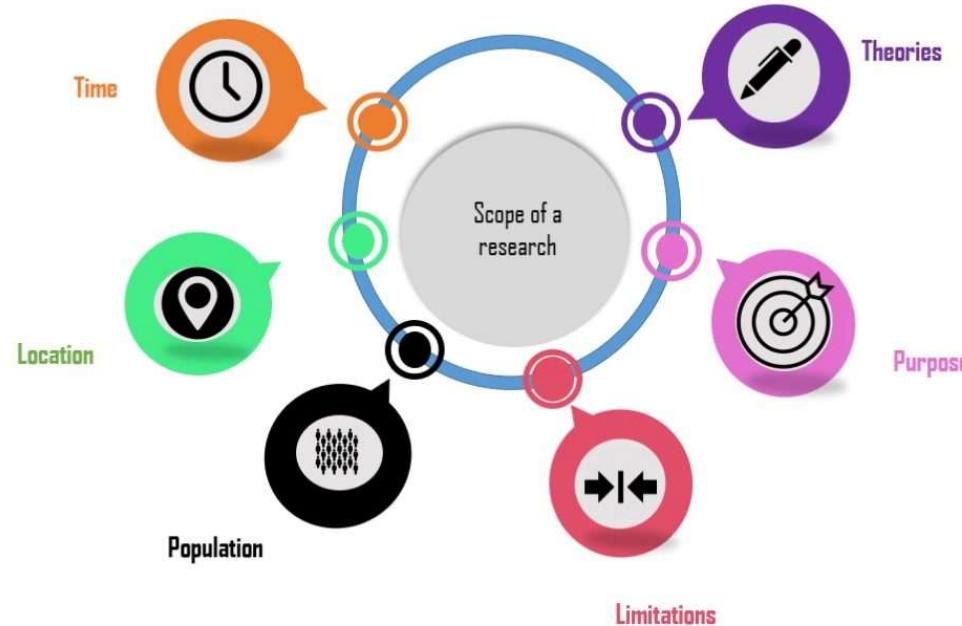
2. To study and perform critical analysis of the state-of-the-art authentication techniques for securing the IoT-based networks.
3. To design and implement a lightweight authentication key agreement technique for secure communication in the IoT-based networks.
4. To incorporate a mechanism for dynamic addition of network entities after the initial deployment for ensuring scalability.
5. To analyze and evaluate the performance of the proposed technique in terms of lightweight and security features using the benchmark evaluation metrics, and compare with the existing techniques

Research Scope and Contribution

Prepared by: HSM, NAG and SUH

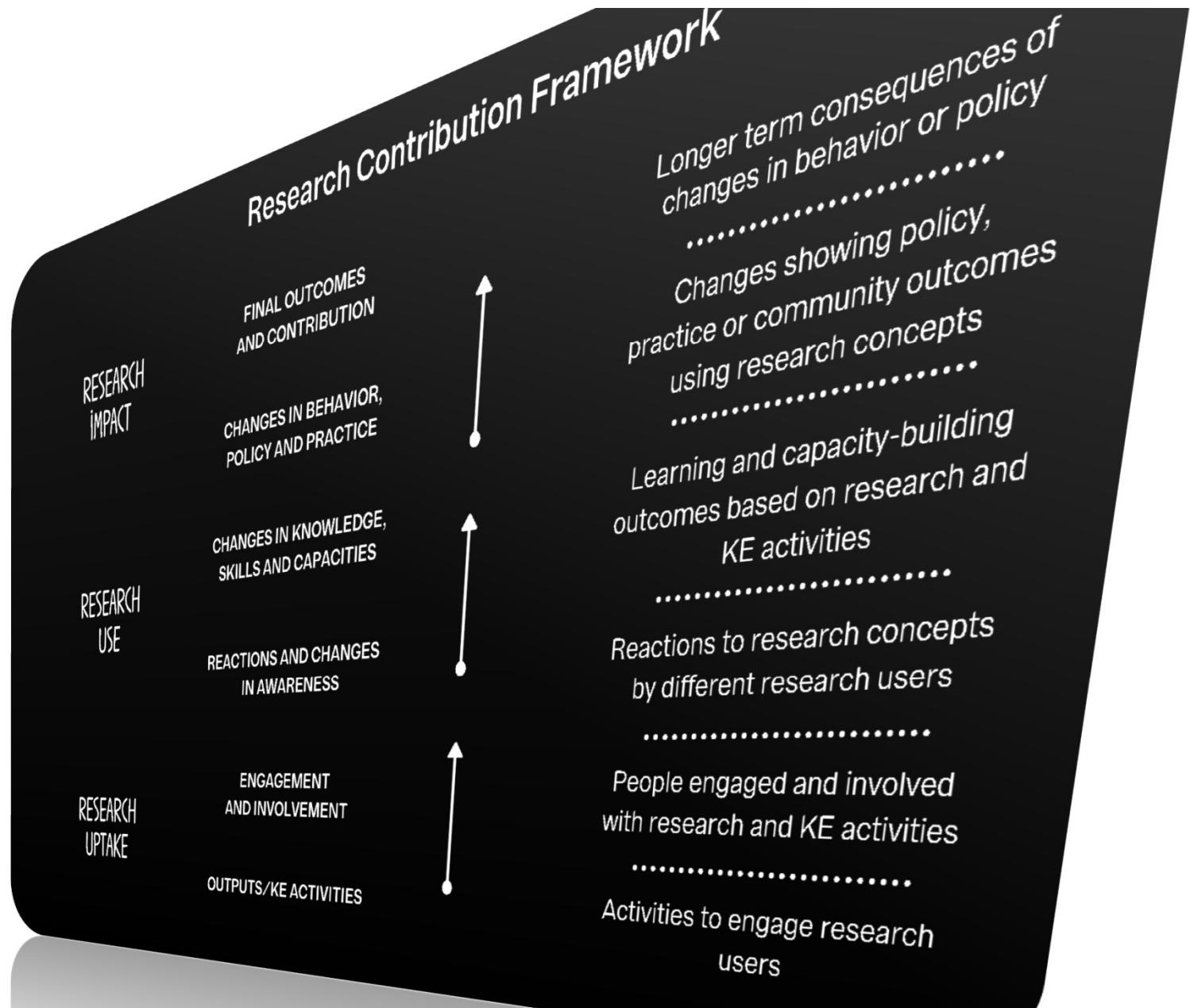
Research Scope

The scope of a study explains the extent to which the research area will be explored in the work and specifies the parameters within the study will be operating.



Contribution could be

theoretical
methodological
contextual
practical



Class Activity

Estimated time - 1 hour

Find 1 article related to your research interest and complete the table below by identifying the PS, RO. Justify is the outcome/contribution was related to the objective set in the research.

PS	RO	Justification of the Outcome

THANK YOU

WOX7001 - RESEARCH METHODOLOGY

Topic 3 - Literature Review

Agenda

01

LR
OVERVIEW

02

LR PROCESS

03

LR
STRUCTURE

04

FINDING
ARTICLE

05

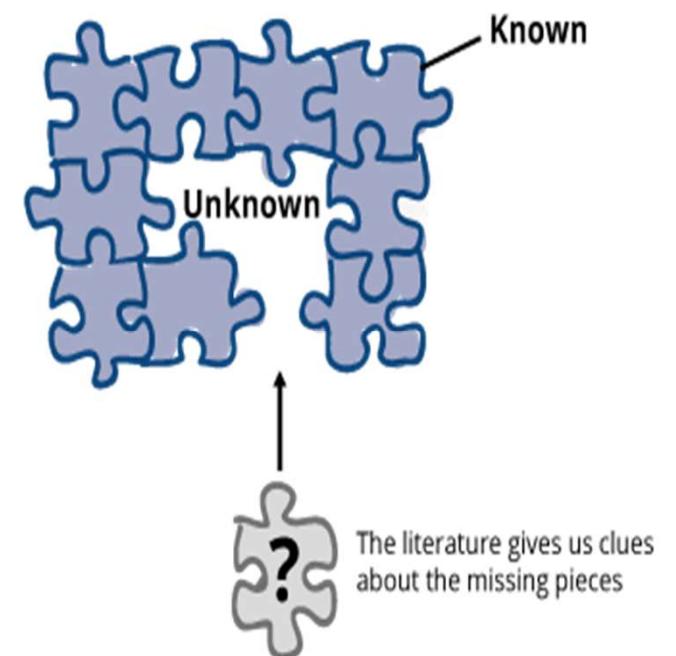
CLASS
ACTIVITIES

LR

- A survey of scholarly sources on a specific topic
- It provides an overview of current knowledge, allowing you to identify relevant theories, methods, and gaps in the existing research
- As well as looking at what's already known, it seeks to point out what isn't yet known – often to provide a justification for your own research.
- As part of a longer piece of research, it's there to ensure you have a thorough understanding of the existing research in your area before embarking on your own.

We know there is a problem, then Why must perform LR?

- Helps to determine whether the topic is worth studying
- Provides insight into ways in which the researcher can limit the scope to a needed area of inquiry



LR Gives a chance to....

- demonstrate your familiarity with the topic and scholarly context
- develop a theoretical framework and methodology for your research
- position yourself in relation too the researchers and theorists
- show how your research addresses a gap or contributes to a debate

LR Aim to...



Develop the foundation of research base



To learn methods and approaches that are appropriate for your study



To learn appropriate theory to underpin your work



Provide guideline to design the experimental setup



Assist to collect appropriate data

Literature comes from....

Primary Sources

- Included all sources that are original
 - provide first-hand information that is closest to the object of study
 - vary by discipline
1. Peer reviewed research articles
 2. Patent
 3. Conference proceedings
 4. Case studies
 5. Interview
 6. Dissertations/thesis
 7. Newspapers (sometimes)

Secondary Sources

- provides non-original or second-hand data or information
1. Review articles
 2. Meta analysis
 3. Monographs on a specific subject



Tertiary Sources

- consists of distillation and collection of primary and secondary sources
1. Textbooks
 2. Encyclopedias
 3. Handbooks

The purpose of tertiary literature is to provide an overview of key research findings and an introduction to principles and practices within the discipline

LR Process

Prepared by: HSM, NAG and SUH

Always we have an questions on where to start??

Start with your research topic/title

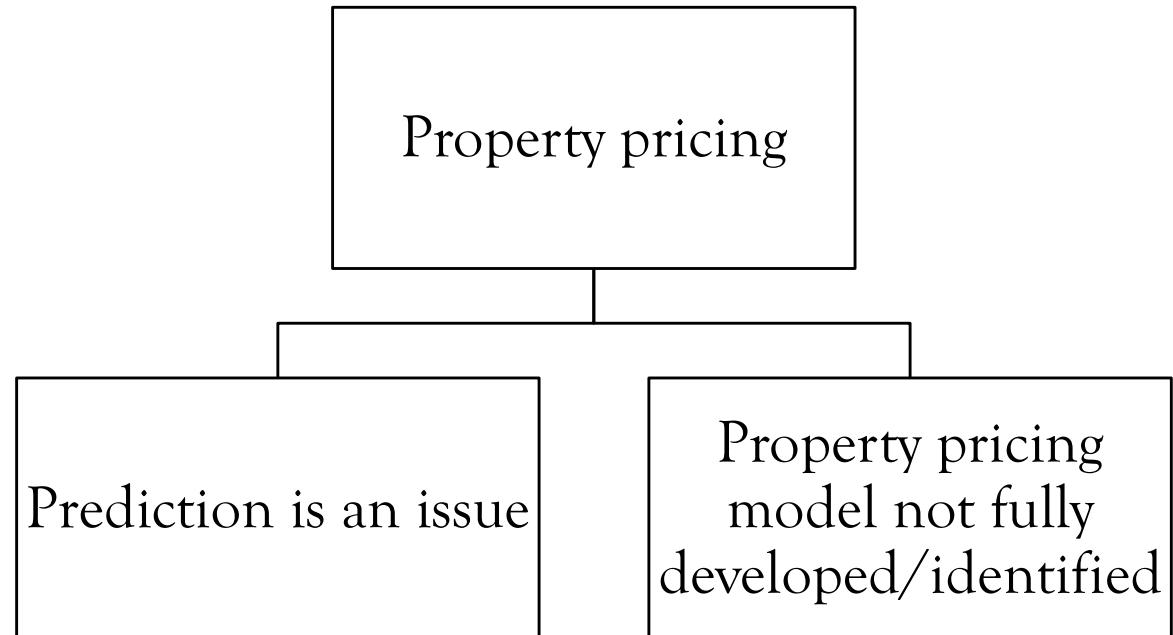
The topic is the subject or subject matter of a proposed study- e.g. “faculty teaching,” “organizational creativity,” or “psychological stress”

Describe the topic in a few words or in a short phrase

The topic becomes the central idea to learn about or to explore

Extracting terms from the topic

- Find the main domain and sub domain
- Example as follows:



LR Structure

Prepared by: HSM, NAG and SUH

Common Structure

Chronological: Organize by time

Thematic: Organize by theme

Methodological: Organize by methodology

Theoretical: Organize by theoretical approach

LR Taxonomy

- Sample:

Main Domain: Health

Sub Domain:

Physical

Marathon running

Working people

Non-working

List other physical activities

Mental Health

Physiological stresses

psychological stresses

- *the list continue...

LR Taxonomy

Impact of the Covid-19 endemic on the changes in shopping behaviour in Malaysia

Main domain: Retailing

Sub domain:

Shopping behaviour

 in-store shopping

 curbside pickup

 online shopping

Sub domain: factors determining the shopping behaviours

 Fear of health

 Employment status

 Demographic

LR Parameters

How far back will you look for sources? The last 5years/10 years?

What source do you want to cover?

- E.g. Journals/Patent /Government report / Conference
 - Roughly how many sources should need to include?
 - What types of sources (journal articles, websites)?
 - Should you evaluate your sources?
 - Is the source you are using trusted in your field? (check using the Web of Science/Scopus)

Finding Literature

Prepared by: HSM, NAG and SUH

Planning Your Literature Search

Four stages of the literature review:

- a) Problem formulation – which topic or field is being investigated and what are the main issues?
- b) Literature search – finding materials relevant to the subject being explored
- c) Data evaluation – determining which literature makes a significant contribution to the understanding of the topic
- d) Analysis and interpretation – discussing the findings and conclusions of literature



Indexing

WOS
(Web of
Science)

Scopus

Google
Scholar

Academia

Class Activity

Estimated time - 1 hour

Exploration of the Online databases and academic journals

Refer to the following links:

<https://umlibguides.um.edu.my/researchguide/webofscience>

<https://umlibguides.um.edu.my/researchguide/scopus>

(<https://scholar.google.com/>)

<https://academic.microsoft.com/home>

THANK YOU

WOX7001 – RESEARCH METHODOLOGY

Topic 3 - Research Method in Computer Science

Agenda

01

SCIENTIFIC
METHOD

02

RESEARCH
CLASSIFIER

03

RESEARCH
METHODS

04

RESEARCH
PARADIGM

05

CLASS
ACTIVITIES

Scientific method

- Scientists use observations and reasoning to develop technologies and propose explanations for natural phenomena in the form of hypotheses
- Predictions from these hypotheses are tested by experiment and further technologies developed
- Any hypothesis which is cogent enough to make predictions can then be tested reproducibly in this way
- Once it has been established that a hypothesis is sound, it becomes a theory.

Elements of Scientific Method

- Characterisations (Quantifications, observations and measurements)
- Hypotheses (theoretical, hypothetical explanations of observations and measurements)
- Predictions (reasoning including logical deduction from hypotheses and theories)
- Experiments (tests of all of the above)

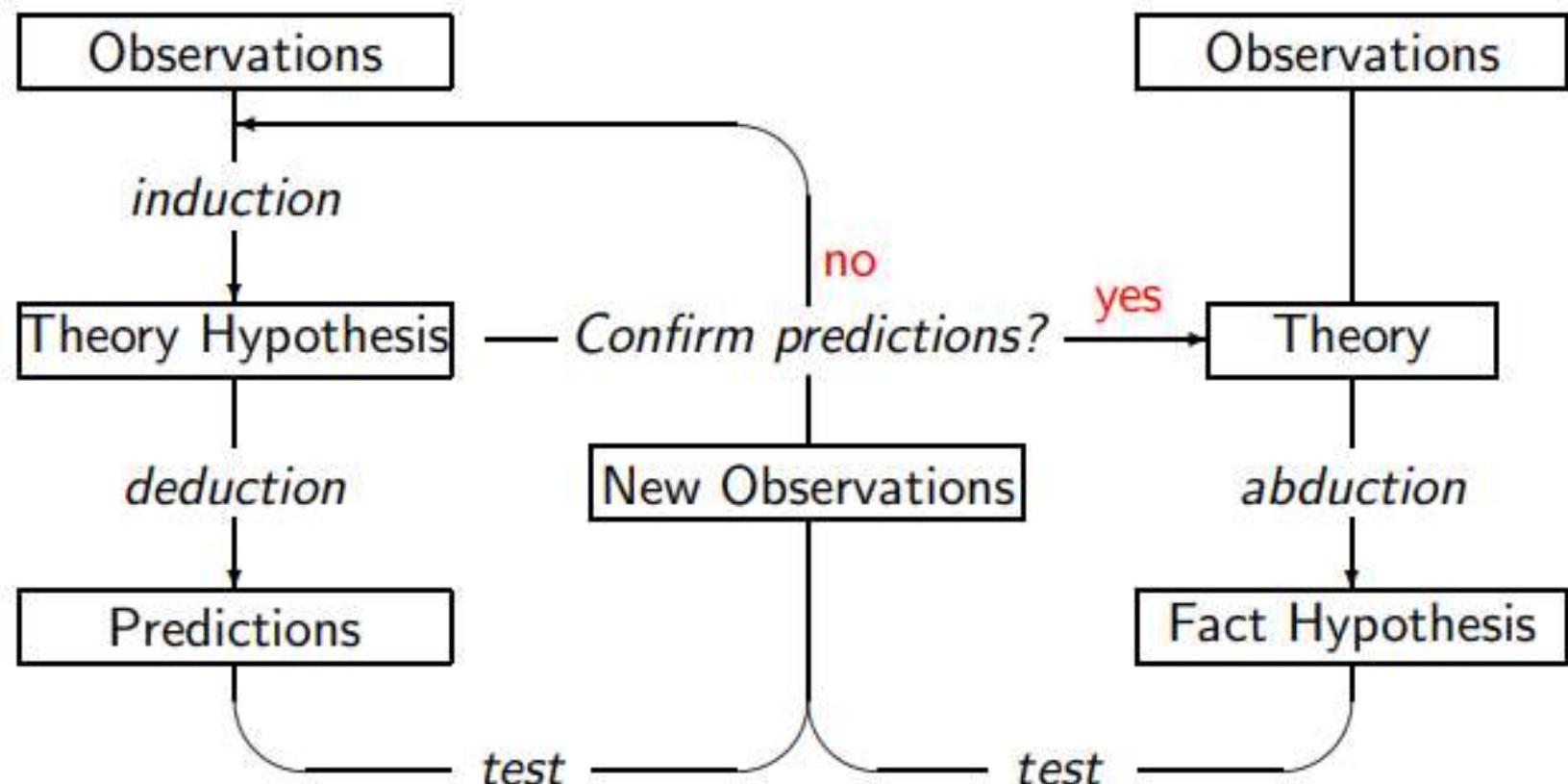
Scientific Method discovers....

- What predictions does a theory make?
- What is the right hypothesis in a particular situation?
- What is the right experiment to conduct?

The process involved in deriving the scientific method....

- Deductive reasoning (proceeds from our knowledge of the world (theories) and predicts ‘likely’ observations *Example:* – Assume we know that A implies B. – A has been observed. – Then we should also observe B. – **often lead to new knowledge**
- Abductive reasoning (proceeds from observations to causes. *Example:* – The phenomenon X is observed. – Among hypotheses A, B, C, and D, only A and B are capable of explaining X. – Hence, there is a reason to assume that A or B holds. **Useful for hypothesis generation**
- Inductive reasoning (proceeds from a set of observations to a general conclusion *Example:* – Tycho Brahe, a 16th century astronomer, collected data on the movement of the Mars. **Useful for theory formation**

The model for scientific method



Research Classifier

Prepared by: HSM, NAG and SUH

Research Perspective

Field (Position of the research within a hierarchy of topics)

Example:

Artificial Intelligence → Automated Reasoning →
First-Order Reasoning → Decidability

Approach (Research methods that are employed as part of the research process)

Examples:

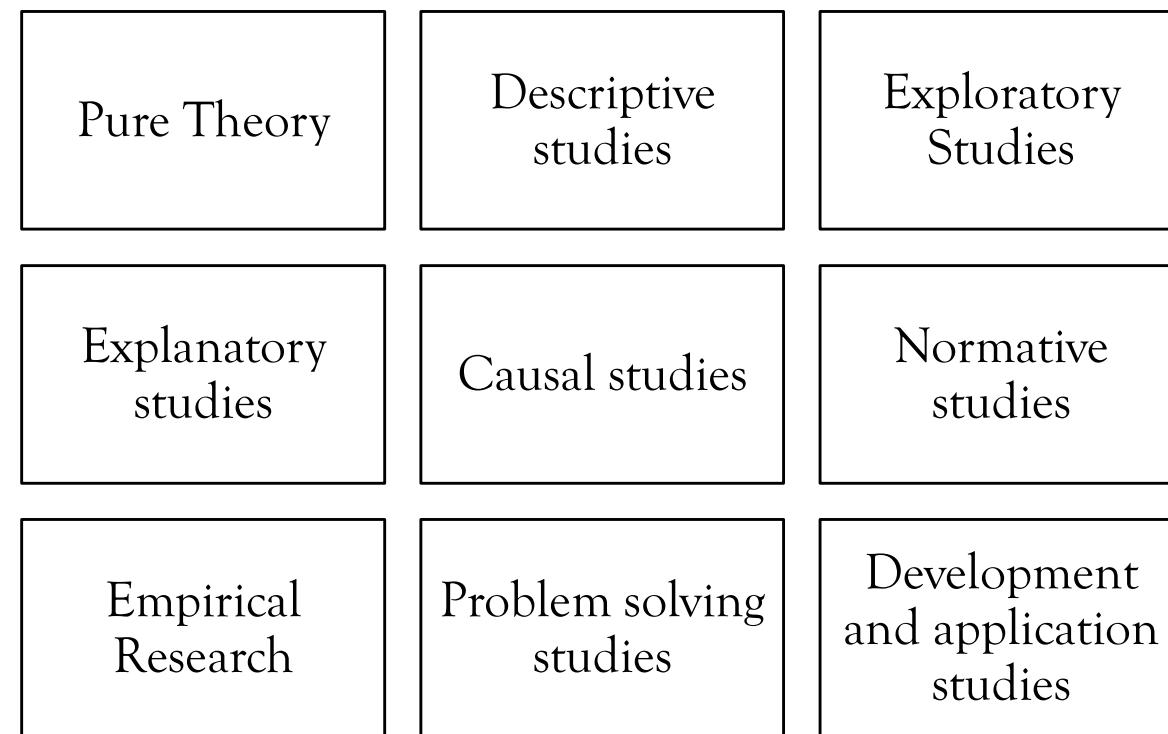
Case study, Experiment, Survey, Proof

Nature (Pure theoretical development)

Review of pure theory and evaluation of its applicability

Applied research

Research Classification



Research Methods

Prepared by: HSM, NAG and SUH

Research Approach

Quantitative research methods Method

associated with measurements (on numeric scales) Stemming from natural sciences

Used to test hypotheses or create a set of observations for inductive reasoning

Accuracy and repeatability of vital importance

Qualitative research Methods

Methods involving case studies and surveys Stemming from social sciences

Concerned with increasing understanding of an area, rather than an explanation

Repeatability usually a problem

Research Methods

Action research:

Pursues action (or change) and understanding at the same time

Continuously alternates between action and critical reflection, while refining methods, data and interpretation in the light of the understanding developed in the earlier cycles

Example: Reflective teaching

Case study:

In-depth exploration of a single situation

Usually generates a large amount of (subjective) data

Should not merely report the data obtained or behaviour observed but attempt to generalise from the specific details of the situation observed

Example: Case study of open source software development

Research Methods

Survey:

Usually undertaken using questionnaires or interviews

Questionnaire and interview design important!

Determination of sample size and sample elements important!

Example: Survey on the popularity or use of programming languages

Experiment:

Investigation of causal relationships using test controlled by the researcher

Usually performed in development, evaluation and problem solving projects

Example: Evaluation of processor performance

Research Paradigm in CS

Prepared by: HSM, NAG and SUH

Research Paradigm in CS

Empirical:

Computer science is concerned with the study of a class of phenomena

Mathematical:

Computer Science is concerned with the study of algorithms and properties of information structures (abstraction from real objects)

Engineering:

managing the cost-effective design and construction of complex software-hardware systems (commercially and socially valuable)

Experimental Techniques

Depending on the objective, various evaluation techniques shall be used

Quantitative testing/experiments of algorithms/programs/databases/...

Usability tests with users

Questionnaires

Surveys

Case studies

Parameters.....

Runtime

Preprocessing time

Disk space (overhead)

Memory

Correctness of results

Accuracy of approximation algorithms

User satisfaction

Usability

So, in order to experiment we need Data set

Real-world data

- Always good to have – show that system works in practice
- Sometimes difficult to obtain
- Do not allow to test all aspects of an algorithm/system

Synthetic data

- Allow to test specific aspects of the algorithm
- Often (very) difficult to generate
- If possible, try to use the same data as your competitors

It is easy to show that your approach is better if only very particular data is used
Describe the most important aspects of the data

After experiment, compare the solution (Benchmarks)

Use existing benchmarks as much as possible

Facilitates the comparison of different solutions

Class Activity

Estimated time - 1 hour

Identify the following for your research title:

1. Which scientific method is suitable?
2. It falls under which research perspective?
3. The research classification?
4. Research approach?
5. Research method?
6. It belongs to which research paradigm in CS?
7. What technique to align with the selected research paradigm?

THANK YOU



WOX7001 – RESEARCH METHODOLOGY

Topic 5 - Quantitative Research



Agenda

01

SAMPLE

02

RESEARCH
ETHICS

03

RESEARCH
DATA

04

RESEARCH
INSTRUMENT

05

CLASS
ACTIVITIES

Quantitative Research is...

- Quantitative research is the process of collecting and analyzing numerical data
- is a systematic investigation of phenomena by gathering quantifiable data and performing statistical, mathematical, or computational techniques
- collects information from existing and potential customers using sampling methods and sending out online surveys, online polls, and questionnaires
- can be used to find patterns and averages, make predictions, test causal relationships, and generalize results to wider populations.
- widely used in the natural and social sciences: biology, chemistry, psychology, economics, sociology, marketing, etc.

Characteristics of quantitative research ...

Structured tools:

- Structured tools such as surveys, polls, or questionnaires are used to gather quantitative data.
- Using such structured methods helps in collecting in-depth and actionable data from the survey respondents.

Sample size:

- conducted on a significant sample size that represents the target market.
- Appropriate sampling methods have to be used when deriving the sample to fortify the research objective

Close-ended questions:

- Closed-ended questions are created per the objective of the research.
- help collect quantitative data and hence, are extensively used in quantitative research.

Characteristics of quantitative research ...

Prior studies:

- Various factors related to the research topic are studied before collecting feedback from respondents.

Quantitative data:

- Usually, quantitative data is represented by tables, charts, graphs, or any other non-numerical form.
- This makes it easy to understand the data that has been collected as well as prove the validity of the market research.

Generalization of results:

- Results of this research method can be generalized to an entire population to take appropriate actions for improvement.

Advantages of quantitative research...

- Collect reliable and accurate data
- Quick data collection
- Wider scope of data analysis
- Eliminate bias

Population and Sample

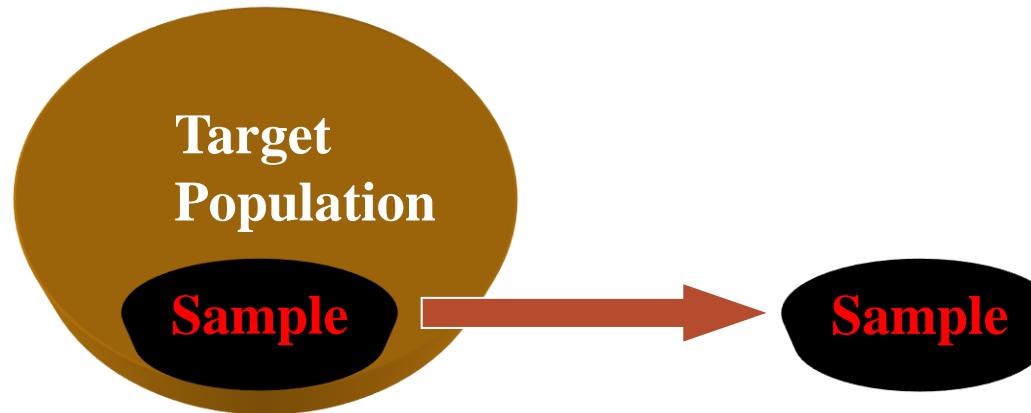
- A population is a group of individuals that comprise the same characteristics
- A sample is a sub-group of the target population that the researcher plans to study for the purpose of making generalizations about the target population.
- Samples are only estimates
- The difference between the sample estimate and the true population is the “sampling error.”

Who Will You Study? Identifying The Unit of Analysis

- Unit of analysis is the level (e.g. individual, family, school, school district) at which the data will be gathered.
- There may be different units of analysis
 - one for the dependent variable
 - one for the independent variable

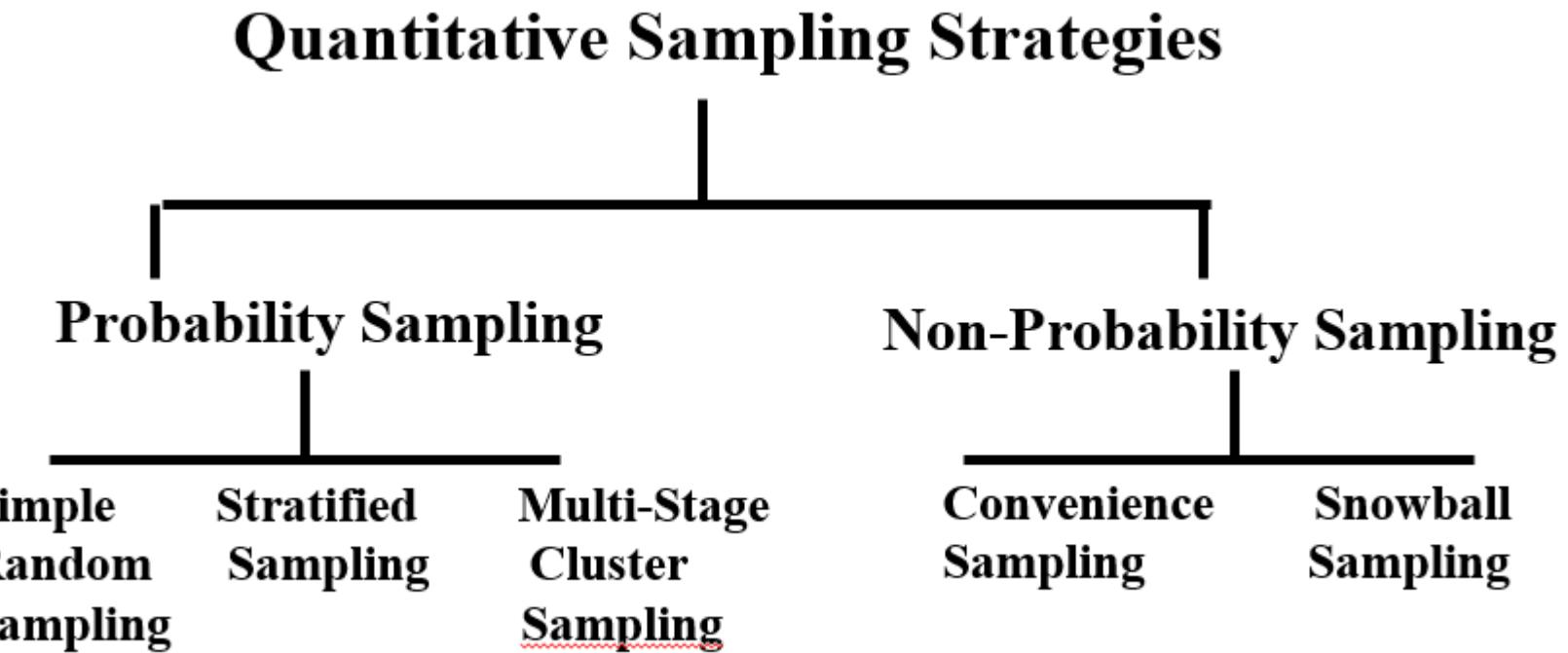
Population and Samples

All teachers in high schools in one city
College students in all community colleges
Adult educators in all schools of education



All high school biology teachers
Students in one community college
Adult educators in 5 schools of education in the Midwest

Type of Quantitative Sampling



Types of Probability Samples

Simple Random:

selecting a sample from the population so all in the population have an equal chance of being selected

Systematic:

choosing every “nth” individual or site in the population until the desired sample size is achieved

Types of Probability Samples

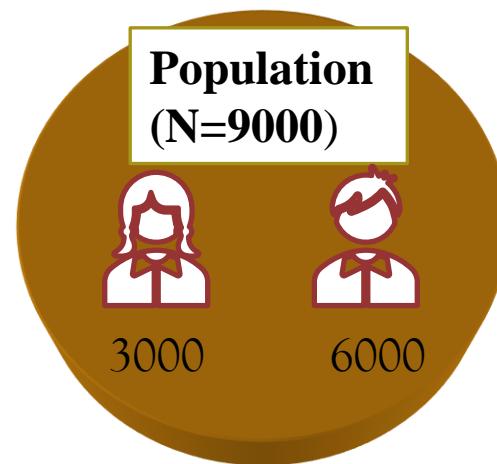
Multi-Stage Cluster Sampling:

a sample chosen in one or two stages because the population is not easily identified or is large

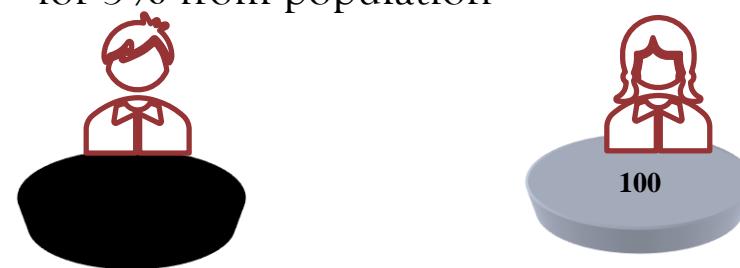
Stratified sampling:

stratifying the population on a characteristic (e.g. gender) then sampling from each stratum.

Proportional Stratification Sampling Approach



Let's say from literature I have decided go for 3% from population



Sample = 300

Types of Non-Probability Samples

Convenience Sampling:

participants are selected because they are willing and available to be studied

Snowball Sampling:

the researcher asks participants to identify other participants to become members of the sample.

Research Ethics Application

Prepared by: HSM, NAG and SUH

What Permissions Will You Need? Obtaining Permission

Institutional or organizational (e.g. school district)

Site-specific (e.g. secondary school)

Individual participants or parents

Campus approval (e.g. university or college) and Institutional Review Board (IRB)

Research Data and Instrument

Research Instrument

An instrument is a tool for measuring, observing, or documenting quantitative data

Types of Instruments

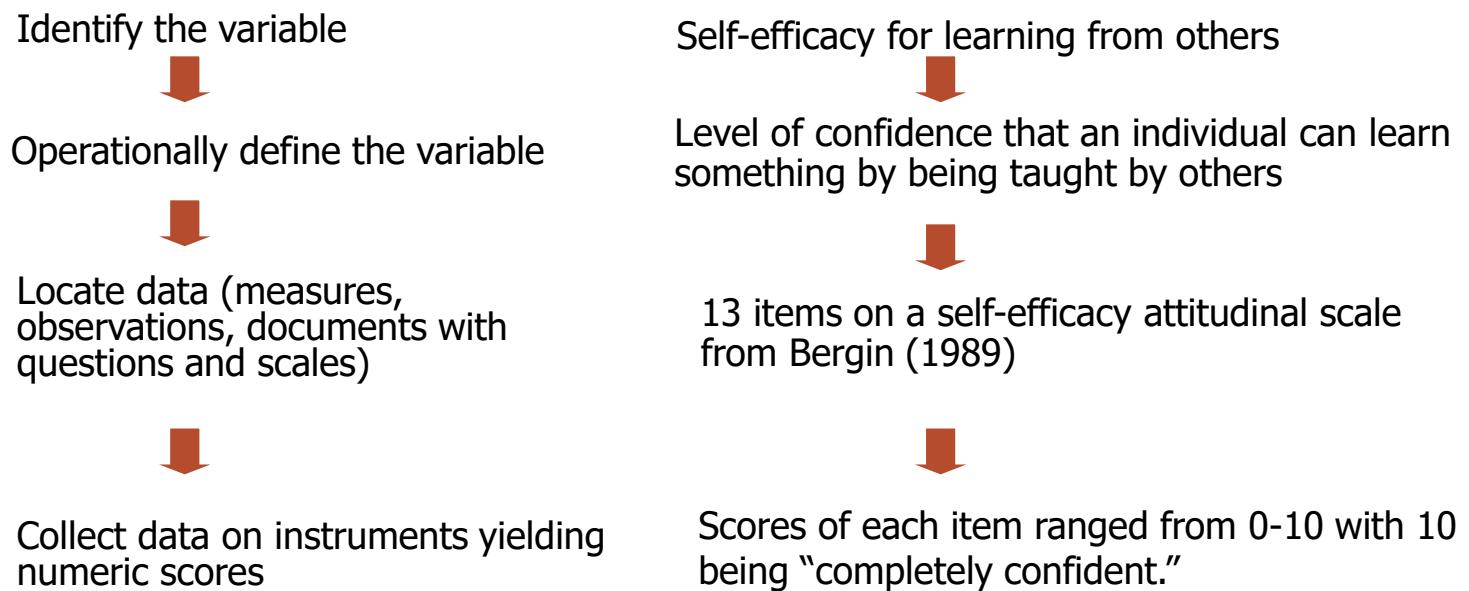
Performance Measures (e.g. test performance)

Attitudinal Measures (measures feelings toward educational topics)

Behavioral Measures (observations of behavior)

Factual Measures (documents, records)

Linking data collection to variables and questions



What Instruments Will You Use To Collect Data? Locating or Developing an Instrument

Look in published journal articles

Run an ERIC search and use the term “instruments” and the topic of the study

Go to ERIC web site for Evaluation and Assessment

Examine guides to commercially available tests

Develop your own instrument

Criteria for choosing a good instrument: Reliability

Reliability: Scores from measuring variables that are stable and consistent

Example: Bathroom scale

Types of reliability

Test-retest (scores are stable over time)

Alternate forms (equivalence of two instruments)

Alternate forms and test-retest

Inter-rater reliability (similarity in observation of a behavior by two or more individuals)

internal consistency (consistent scores across the instrument)

Criteria for choosing a good instrument: Validity

Validity: Scores from measuring variables that are meaningful

Types of validity

Content (representative of all possible questions that could be asked)

Criterion-referenced (scores are a predictor of an outcome or criterion they are expected to predict)

Construct (determination of the significance, meaning, purpose and use of the scores)

Criteria for choosing a good instrument: Scales of Measurement

Nominal (Categorical): categories that describe traits or characteristics participants can check

Ordinal (Categorical): participants rank order a characteristic, trait or attribute

Interval (Continuous): provides “continuous” response possibilities to questions with assumed equal distance

Ratio (Continuous): a scale with a true zero and equal distances among units

How Will You Administer the Data Collection? Procedures for Administering the Data Collection

Develop standard written procedures for administering an instrument

Train researchers to collect observational data

Obtain permission to collect and use public documents

Respect individuals and sites during data gathering (ethics)

How Will You Administer the Data Collection? Procedures for Administering the Data Collection

Develop standard written procedures for administering an instrument

Train researchers to collect observational data

Obtain permission to collect and use public documents

Respect individuals and sites during data gathering (ethics)

After experiment, compare the solution (Benchmarks)

Use existing benchmarks as much as possible

Facilitates the comparison of different solutions

Class Activity

Estimated time – 1 hour

Refer to the article given, answer the following questions

Structured Tool	
Population	
Sample	
Probability/Non Probability	
Types of sampling	
Prior studies	
Hypothesis	
Findings	

THANK YOU

WOX7001 - RESEARCH METHODOLOGY

Topic 6 - Qualitative Research

Agenda

01

PARTICIPANTS

02

INFORMATION

03

RESEARCH
DATA AND
INSTRUMENT

04

CLASS
ACTIVITIES

Population and Sample

Random “Quantitative” Sampling

Select Representative individuals

→ To generalize from sample to population

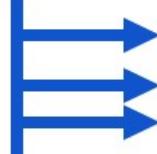


To make claims about the population
To build/test “theories” that explain the population

Purposeful “Qualitative” Sampling

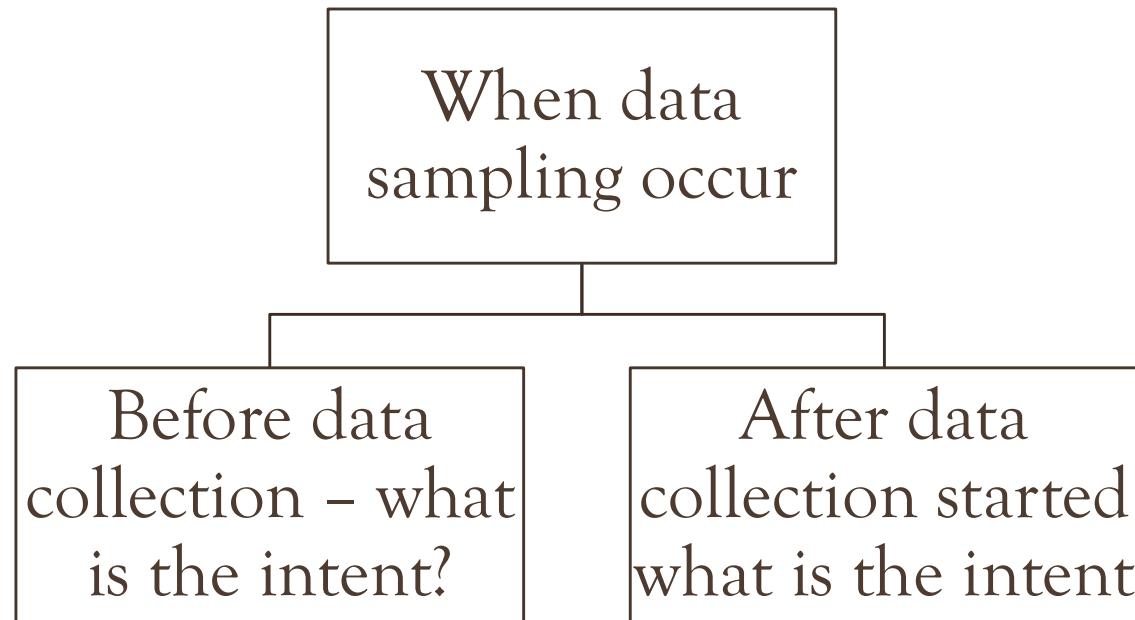
Select people/sites who can best help us understand our phenomenon

→ To develop detailed understanding



That might be “useful”: information
That might help people “learn” about the phenomenon
That might give voice to “silenced” people

Purposeful Sampling



Before Data Collection

To develop many perspectives	Maximal variation sampling	A researcher is conducting a door to door survey to find attitudes towards single parents.
To describe particularly Troublesome or enlightening cases	Extreme case sampling	if you were studying inner city violence, you could study a city with high violence and compare it to a city with low violence
To describe what is “typical” to those unfamiliar with the case	Typical sampling	spending habits of a city in a middle-class suburb (typical) rather than from a poor or rich suburb
To generate a theory or concept	Theory/concept sampling	Grounded theory
To describe some sub-group in depth	Homogeneous sampling	people in a homogeneous sample might share the same age, location or employment.

After Data Collection

To take advantage of whatever case unfolds	Opportunistic sampling	standing on the street asking passers by to join the research.
To locate people or sites to study	Snowball sampling	a researcher who is seeking to study leadership patterns could ask individuals to name others in their community who are influential.
To explore confirming or disconfirming cases	Confirming/disconfirming sampling	Confirmatory cases are additional examples that fit already emergent patterns to add richness, depth and credibility. Disconfirming cases are a source of rival interpretations as well as a means for placing boundaries around confirmed findings

Sample Size

Small for in-depth perspective

1 individual

4 cases

20-30 interviews

What permission are needed

Gain permission from Institutional Review Board (IRB)

Gain permission from “gatekeepers” at the research site

Gatekeepers: individuals at the site who provide site access, help researcher locate people and identify places to study. The gatekeeper may require written permission about the project

Think of some sample of research
gatekeeper

Information (Qualitative)

Prepared by: HSM, NAG and SUH

Information for the gatekeeper

Why their site was chosen
What time and resources are required
What will be accomplished at the site
What potential there is for your presence to be disruptive
What individuals at the site will gain from the study
How you will use and report the results

What Information will you collect?

Observation

Interviews

Documents

Audio-video materials

Observations

An Observation is the process if gathering first-hand information by observing people and places at a research site.

Observational roles

Participant observer

Non-Participant observer

Observational roles can be changed

Observations

Conduct multiple observations

Record both descriptive and reflective field notes during the observation

Descriptive field notes describe the events, activities and people

Reflective field notes record personal reflections that relate to their insights, hunches or broad themes that emerge

Interviews

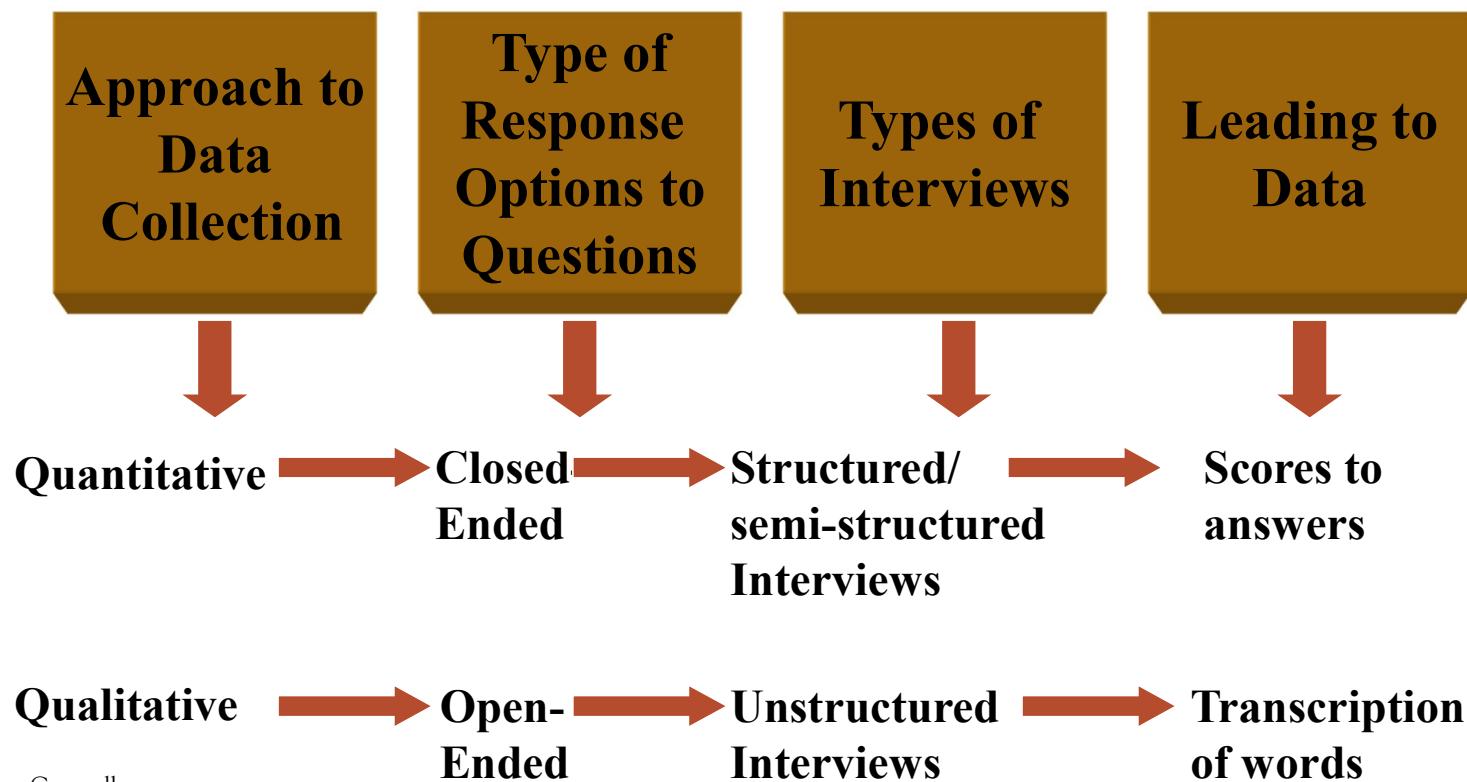
Types: Personal, Phone, e-mail, Focus Group

General open-ended questions are asked

allows the participant to create options for responding
participants can voice their experiences and perspectives

Information is recorded then transcribed for analysis

Structured, unstructured, and semi-structured interviews



Documents

Public and private records

Good source for text data

You must obtain permission before using documents

Optically scan documents when possible

Audio-Visual materials

Determine the material that can provide evidence to address your research questions

Determine if the material is available and obtain permission to use it

Check the accuracy and authenticity of the material if you do not record it yourself

Collect the data and organize it

Stopped here

How will you record data?

Using protocols

Observation protocols

Interviewing protocols

Interview protocols

The header: essential information about the interview

Open-ended questions include
“ice-breaker”
ones that address major research questions
probes that clarify and elaborate

Closing comments thanking the participant

Observational protocols

The header: essential information about the interview

Left column to record descriptive notes

Right column to record reflective notes

A picture of the site may be sketched

How do you administer data collection?

Time needed for data collection

- Limit initial collection to one or two observations or interviews

- Time is needed to establish a substantial data base

Obtaining permission to use materials

Ethical issues

- Anonymity of participants

- Convey true purpose of study without deception

Research Data and Instrument

Prepared by: HSM, NAG and SUH

Research Instrument

An instrument is a tool for measuring, observing, or documenting qualitative

Types of Instruments

Interview questionnaire

Checklist for observation

Document analysis

A SNIPPET OF RESPONSES TO ONE INTERVIEW QUESTION POSED TO THREE RESEARCH PARTICIPANTS

Researcher question (open ended): I understand all of you have been teaching high school continuously for 40 years or more. What advice do you have for teachers beginning their first year of teaching?

Teacher 1: I was scared the first year or two, almost every day. Not for my safety or anything like that, but I kept thinking I might fail, maybe my students wouldn't learn anything. I was not that much older than my students. Now, of course, I'm more like a grandmother figure to them. I was worried they would not take me seriously—you know, cut up and take advantage of a young, first-year teacher. Maybe my insecurity showed, maybe they saw my lack of confidence or figured I didn't know what I was doing because I was not very experienced. Now, of course, I think how silly to have worried about such things. So, to answer your question, I would say, "Don't worry, be happy."

Code: Overcome insecurity

I know some people say "Forget everything you learned in your teacher prep program [pause], real learning goes on in the trenches." Sure, you learn by doing, but some old ideas in teaching textbooks are time honored and priceless.

Code: Use learning theory

I recall one theory that focused on time, you know, all kids can learn if given enough time. That's so true. If new teachers know that fact, then they won't get frustrated. They will know that learning algebra, for example, will eventually happen with more time, maybe after school, maybe during the summer. New teachers have to know some kids learn really fast; others, really slow. But they do learn. But there is a clock with a buzz, so I know time runs out. Before time runs out, the teacher should try something new, maybe explaining it with a sketch on paper—yeah, that's it. Try something new.

Code: Experiment with methods

Teacher 2: I remember I marched into my classroom full of vigor and ready to conquer the world. Boy, did those rascals put me in my place! I remember that I thought about quitting my whole first year, crying on the way home sometimes. My dad was a teacher, and he kept saying the first year is hard—just keep going, he would say. That was hard. [Now, what was your question? Laugh.] Oh yeah, I would tell new teachers that it gets better and better every year, like a fine wine! If it didn't, then why would I stay in the classroom for 40 years!

Code: Brace yourself; it only improves

They have to know that the first year is trial and error. Well, not just the first year; you have to experiment all the time to find the right approach with some students.

Code: Experiment with methods

They should know that you won't be teaching the same way year after year. You can't be a repeating robot. People change with the times; every year can be different. What is that motto? Change is good, or something like that. Sometimes you have to be creative.

Code: Be Flexible; adopt to change

I used to complain about chalk on my clothes; now I complain about lugging my laptop to school. You never know when the school's computer—I think it's a 1988 Apple IIe or something—will crash on you. I use my computer a lot to update grades, make changes to assignments and all that. My students can go to a website 24/7 and learn what to do for homework. So, I guess my advice is to roll with the punches and don't expect a routine. Routines get boring after a while anyway. Yeah, I would say keep changing with the times and welcome new ways of doing things.

Code: Welcome innovation

Everything changes so fast these days anyway.

Teacher 3: I would say prepare to wear many hats. That is because teaching today is very different than when I first started. I would say something like, you are a part-time teacher, part-time counselor, part-time social worker, part-time therapist, even part-time parent! Teaching in the old days was pretty much teaching; today it is far more and new teachers must be prepared for that.

Code: Brace yourself for multiple roles

I don't think they train new teachers to be social workers, but what else can you do when a student comes in hungry and holds back tears? What did she just experience? What do you do when another student comes in acting high on drugs? You see, teaching becomes harder and harder when you know that some students cannot concentrate on learning.

Code: Be prepared for challenges beyond teaching

Many have huge problems that they deal with: I do what I can, but with so many other students, it's just a hard job. I think they call it compassion fatigue, or something like that. I'm one of the lucky ones; I can go to the mountain cabin for most of the summer. Others, I know, take on other jobs during the summer to pay bills. New teachers should know about the challenges from Day 1, challenges that are not related to lesson plans or technology. The problems are not insurmountable. If they were, I would have started a business or something like that instead. I've loved every class, every semester, because you can make a difference in kids' lives. Students comes back sometimes

Instrument Open ended questions - sample

Data interpretation strategies

Method 1: Hierarchy

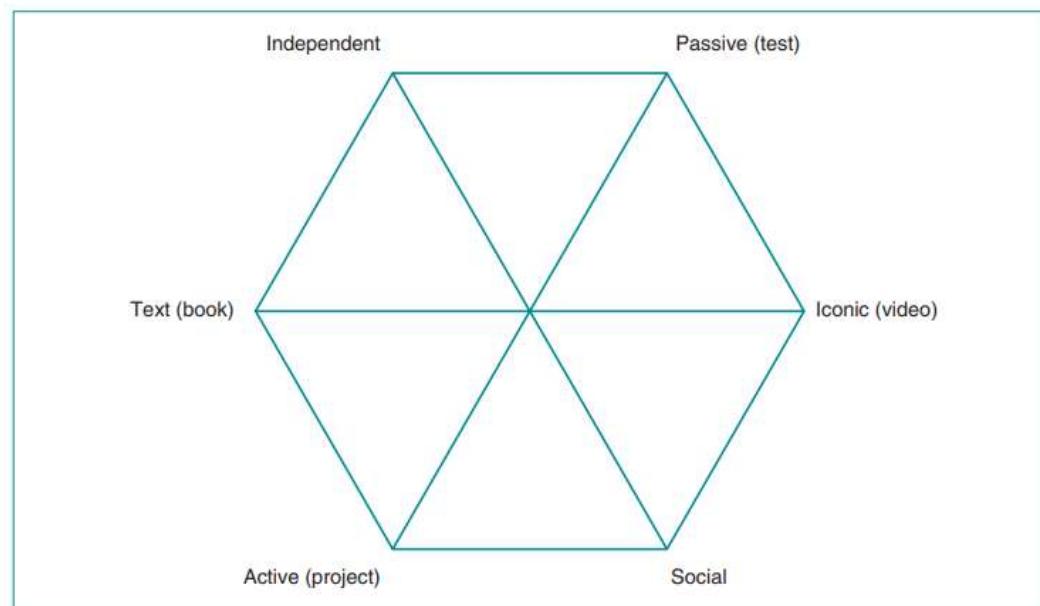
Example after interview the answers transforms into hierarchy as follows. The samples shows Parents' Attitudes Toward Education Displayed as a Hierarchy

Higher Priority			Lower Priority		
Economic	Tradition	Self-Efficacy	Economic	Tradition	Self-Efficacy
Escape Thrive	Continuity Values	Ability Personality	Futility Survive	Expectation Information	Barriers Helplessness

Data interpretation strategies

Method 2: Taxonomies

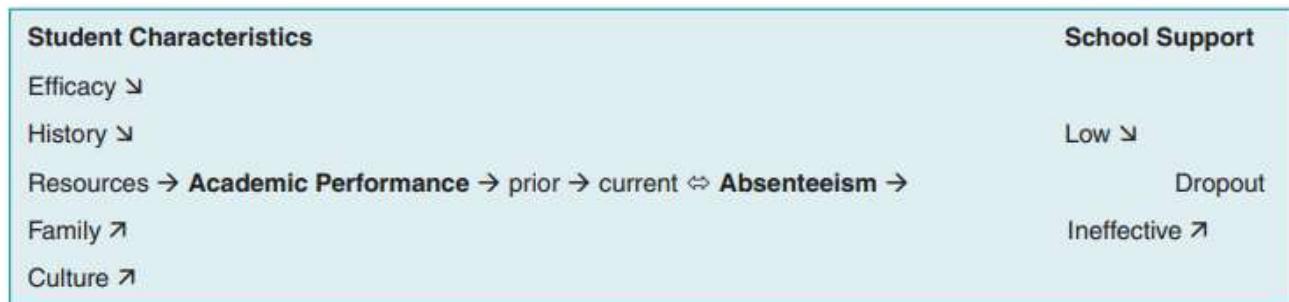
Example after interview the answers transforms into Taxonomies as follows. The samples shows A hypothetical example of different styles of online learning



Data interpretation strategies

Method 3: Network

Example after interview the answers transforms into networks as follows. Network represent the organizational systems that reveal connections with a process that occurs over time. The sample shows the A hypothetical example of a network that reveals linkages in the process of dropout.



Data interpretation strategies

Method 4: Tables and Cross Tabulations

Example after interview the answers transforms into cross tabulations as follows.
The sample shows the Hypothetical Cross Tabulation of Type of Dishonesty and Type of Course.

Type of Dishonesty	Type of Course	
	F2F	Online
Social	Lower	Higher
Nonsocial	Same	Same

THANK YOU



WOX7001 - RESEARCH METHODOLOGY

Topic 7 - Mixed Method Research

Agenda

01

DEFINITION

02

DESIGNING
MIXED METHOD
STUDY

03

MIXED METHOD
RQ

How would you combine two types of data?

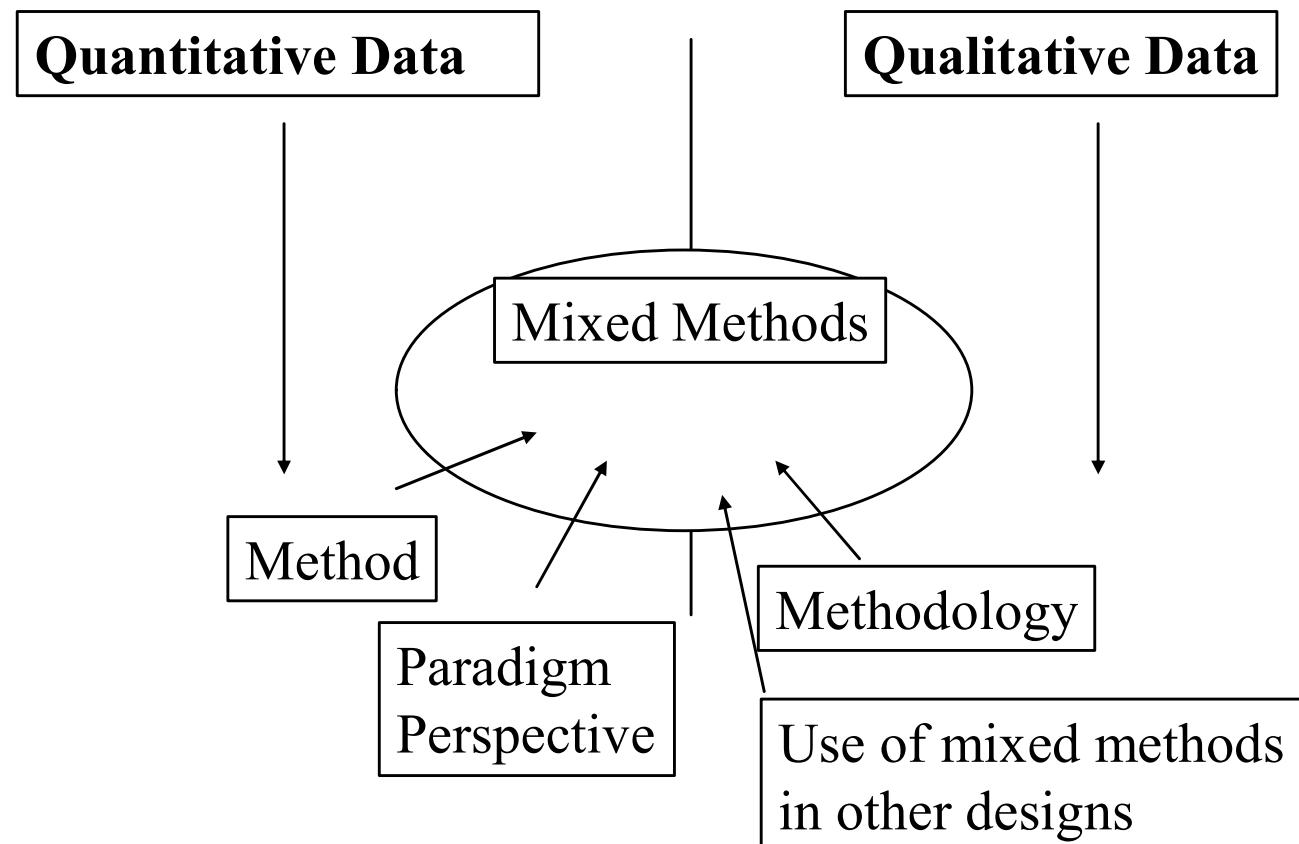
Qualitative Text Data

- ❖ This is a sample of a text file of words that might be collected on interview transcripts, observation fieldnotes, or optically-scanned documents.

Quantitative Numeric Data

- ❖ 2 3 4 2 5 2 3 1 1 2 3 4 2 3 3 2
1 1 1 5 3 4 1 2 3 1 4 4 5 5 4 1
2 1 4 3 3 5 1 4 2 3 1 5 5 2 2 1
5 3 5 1 3 1 5 3 2 2 5 1 3 2 4 4
3 1 2 4 2 2 4 1 5 5 4 2 1 5

Definition/Framework of Mixed Method



A mixed methods researcher...

- Collects both quantitative and qualitative data
- “Mixes” them
- “Mixes” them at the same time (concurrently) or one after the other (sequentially)
- Emphasizes both equally or unequally

A definition...

- *Mixed methods research is both a method and methodology for conducting research that involves collecting, analyzing, and integrating quantitative and qualitative research in a single study or a longitudinal program of inquiry.*
- *The purpose of this form of research is that both qualitative and quantitative research, in combination, provide a better understanding of a research problem or issue than either research approach alone.*

Mixing or linking the data

Converge data:



Connect data:



Embed the data:



What is the reason for using mixed methods?

- ❖ The insufficient argument – either quantitative or qualitative may be insufficient by itself
- ❖ Multiple angles argument – quantitative and qualitative approaches provide different “pictures”
- ❖ The more-evidence-the-better argument – combined quantitative and qualitative provides more evidence
- ❖ Community of practice argument – mixed methods may be the preferred approach within a scholarly community
- ❖ Eager-to-learn argument – it is the latest methodology
- ❖ “Its intuitive” argument – it mirrors “real life”

Designing a Mixed Methods Study

- ❖ Preliminary considerations
- ❖ Creating a title
- ❖ Posing a general question
- ❖ Listing the types of data collection and analysis
- ❖ Making explicit your worldview
- ❖ Identifying your research design
- ❖ Drawing a figure of your design
- ❖ Writing a purpose statement
- ❖ Writing research questions
- ❖ Completing a research plan

List your types of data collection (a review)

- ❖ Quantitative data (closed-ended)
- ❖ Instruments
- ❖ Behavioral checklists
- ❖ Records
- ❖ Qualitative data (open-ended)
- ❖ Interviews
- ❖ Observations
- ❖ Documents
- ❖ Audio-visual materials

Activity – List your sources of data

Quantitative Sources of Data

- ❖ Via questionnaire analysis
- ❖ Via experiments

Qualitative Sources of Data

- Via observation analysis
- Via analysis of interview transcribe

List your approach to data analysis (a review)

- Quantitative analysis
 - Use statistical analysis,
 - For description
 - For comparing groups
 - For relating variables
 - Design-type
- Qualitative analysis
 - Use text and images,
 - For coding
 - For theme development
 - For relating themes
 - Design-type

Make explicit your (theory)

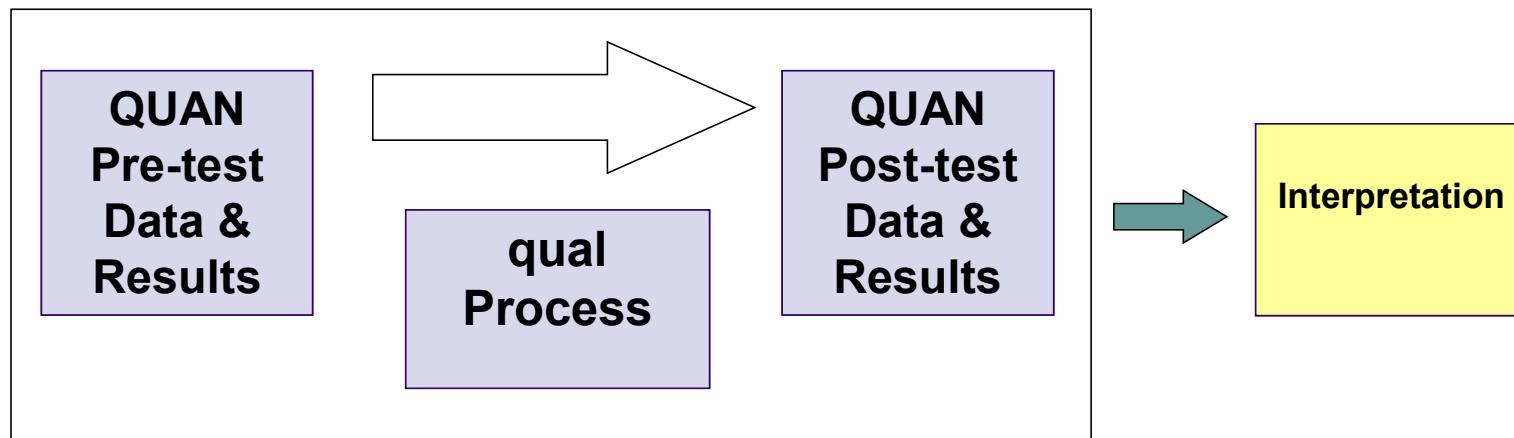
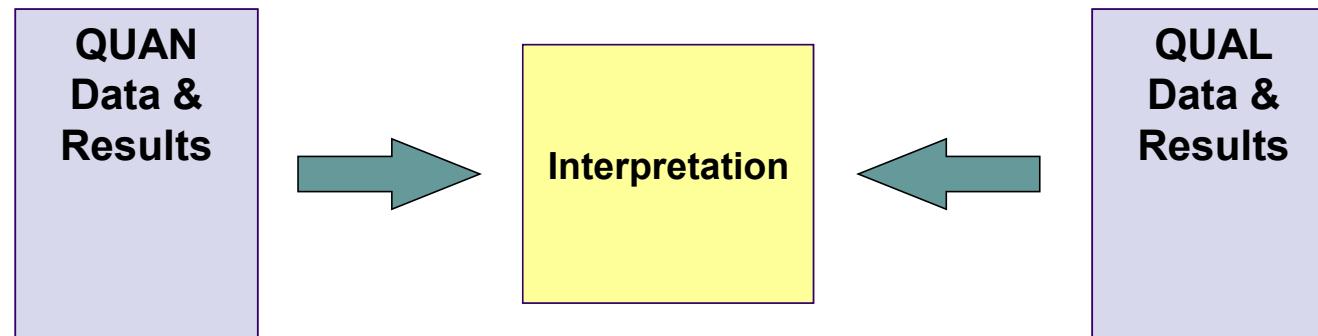
- ❖ Components:

- ❖ What is it
- ❖ Who has used it in your field
- ❖ How it will shape your study (rephrase your guiding research question, if a theory applies)

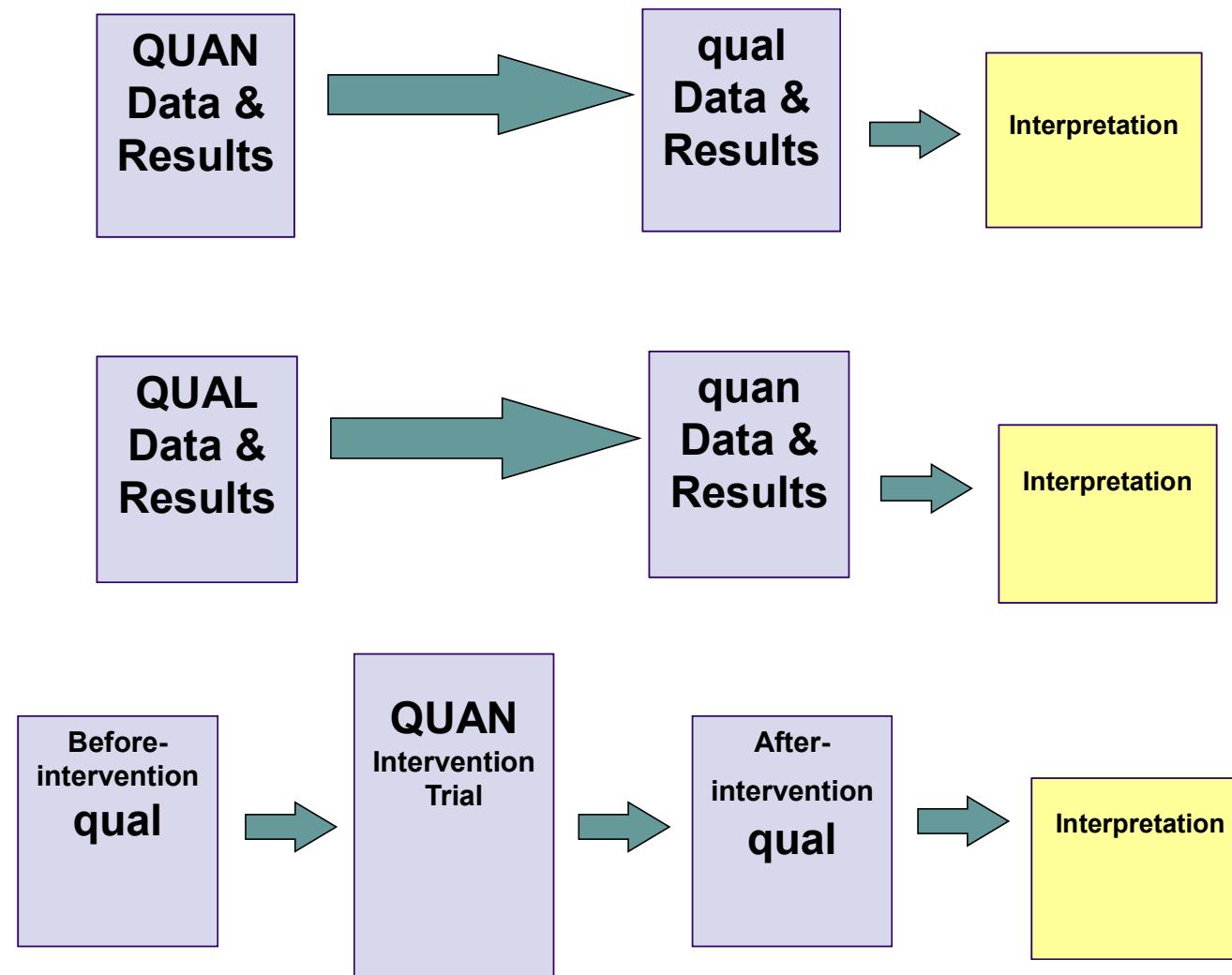
State your procedures (methods)

- ❖ Procedures for handling your qualitative and quantitative data
- ❖ Sequence - concurrent or sequential or both
- ❖ Emphasis - emphasis on qualitative or quantitative
- ❖ Sometimes both concurrent and sequential phases are used
- ❖ Designs may include more than two phases
- ❖ Think about using a simple, elegant design

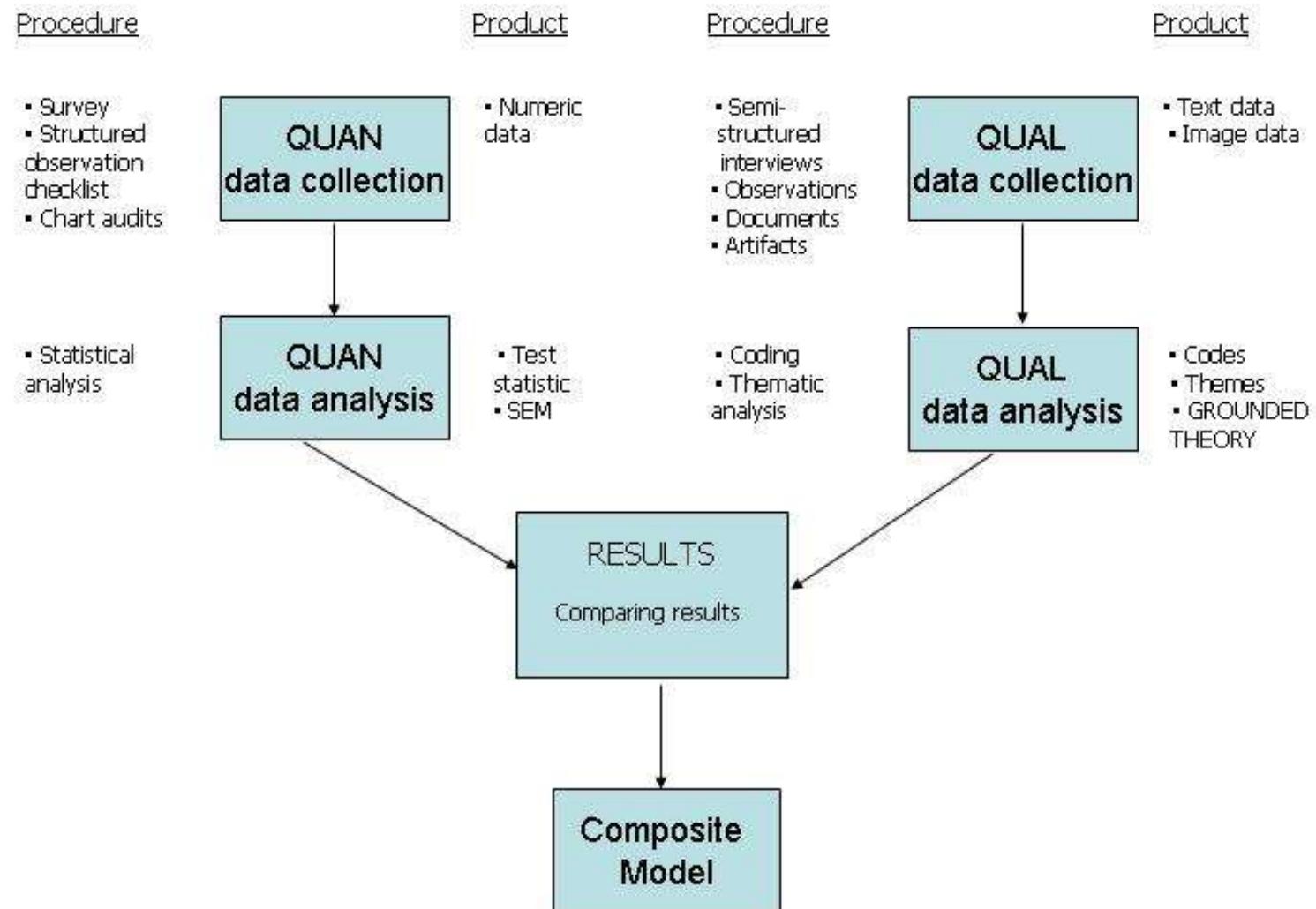
Concurrent Mixed Methods Designs



Sequential designs



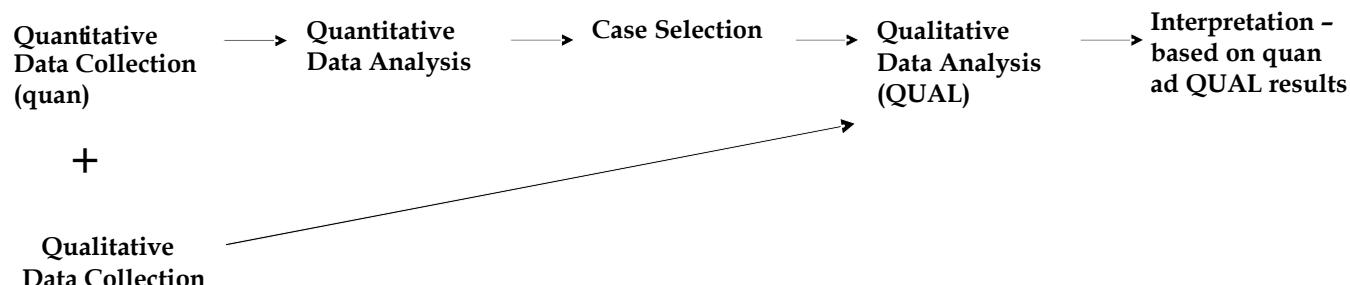
Concurrent Triangulation Design Visual Model



Design options

Design Name	Equal priority	QUAN emphasis	QUAL emphasis
Concurrent, triangulation	QUAL+QUAN	QUAN+qual	QUAL+quan
Concurrent, embedded	n/a	QUAN(qual)	QUAL(quan)
Explanatory, sequential, quan first	QUAN→QUAL	QUAN→qual	quan→QUAL
Exploratory sequential, qual first	QUAL→QUAN	qual→QUAN	QUAL→quan
Sequential, embedded	n/a	(qual) QUAN QUAN (qual)	(quan) QUAL QUAL (quan)

Explanatory sequential design

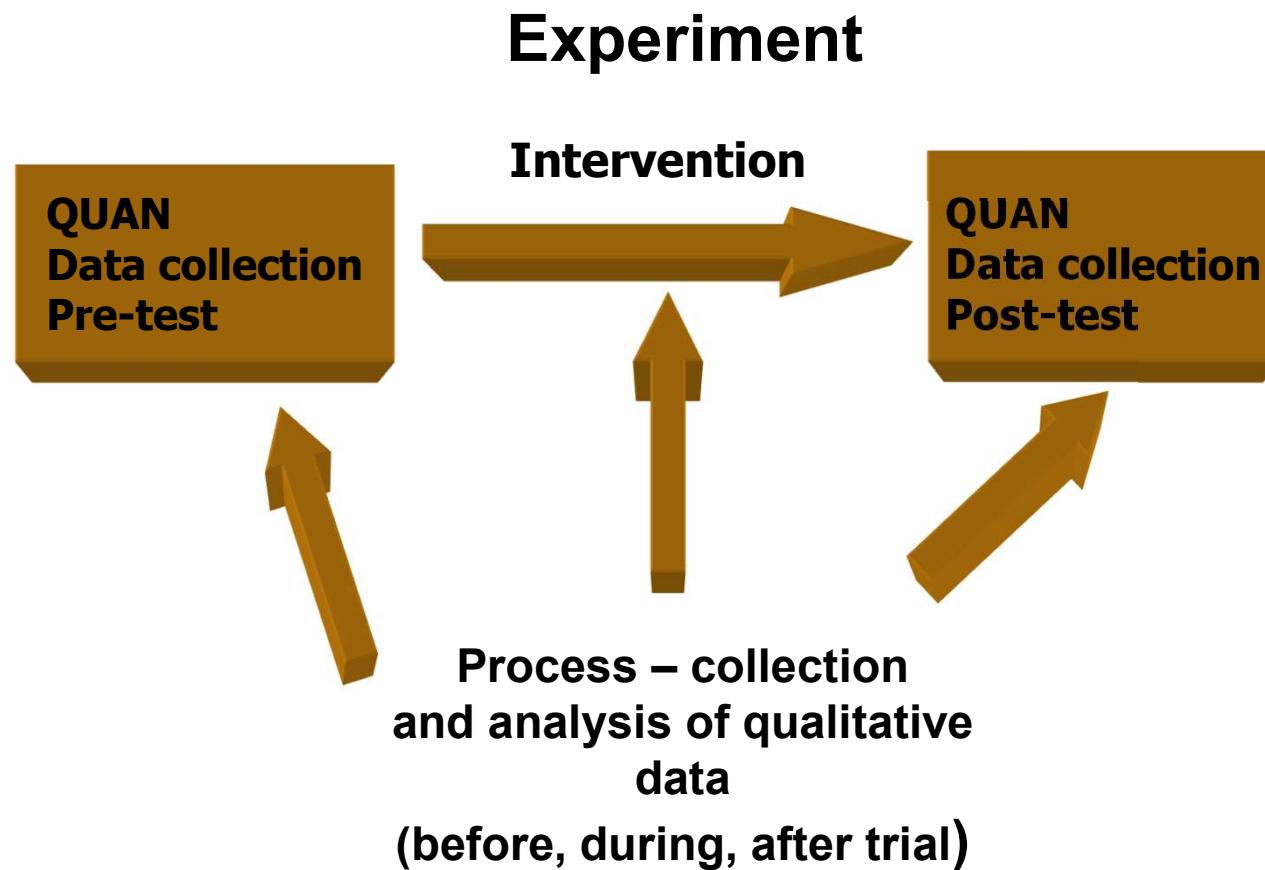


<u>Quantitative Data*</u>	<u>Quantitative Analysis</u>	<u>Case Selection</u>	<u>Qualitative Analysis</u>	<u>Interpretation</u>
Number of cigarettes CESD6	Graphic plot of CES D6 scores over time for each participant	Selected 5 cases maximally varying Identified critical months in which smoking varied	Description of each case Identification of life events occurring during critical months where smoking increased or decreased Thematic analysis of life events for each case Cross-case thematic analysis	Why did changes in smoking occur?
Qualitative Data* Semistructured interviews, audio recorded and transcribed	Graphic plot of cigarettes/day values over time for each participant			

* Data collected 10 times over the course of a calendar year for 40 participants

Source: Creswell, Plano Clark, Shope, McVea. (in progress)

Embedded research design



Mixing the quan and qual data

Type of Mixing	Type of Design	Why Mixing Occurs	Where Mixing Occurs in Research Process
Connecting	Sequential	One phase builds on the other	Between data analysis (Phase 1) and data collection (Phase 2)
Merging	Concurrent	Bring results together	After analysis of both quan and qual - typically in discussion
Embedding	Sequential or Concurrent	Either building or bringing results together	Either between phases or in discussion after analysis

Write a purpose statement for mixed method

This mixed methods study will address _____ (overall content aim of the study). An embedded mixed method design will be used, and it is a design in which one data set provides a supportive, secondary role in a study based primarily on the other data set. The primary purpose of this study will use _____ (quantitative instruments) to test the theory of _____ (the theory) that predicts that _____ (independent variables) will influence _____ (positively, negatively) the _____ (dependent variables or outcomes) for _____ (participants) at _____ (the research site). A secondary purpose will be to gather qualitative data _____ (type of qualitative data, such as interviews) that will explore _____ (the central phenomenon) for _____ (participants) at _____ (site). The reason for collecting the secondary database is _____ (e.g., to address different question, to provide support for the primary purpose).

Writing research questions/hypotheses in mixed methods research

- ❖ Write qualitative research questions and write quantitative research questions/hypotheses
- ❖ Also write a mixed methods research question
- ❖ Write these questions separately

A mixed methods question

Three ways to write this question:

Methodologically-focused:

- ❖ To what extent do the qualitative results confirm the quantitative results?

Content-focused:

How do the interviews with adolescent boys support the quantitative results that their self-esteem changes during the middle school years?

Hybrid of quantitative and qualitative elements:

- ❖ What results emerge from comparing the exploratory qualitative data about boy's self-esteem with outcome quantitative instrument data measured on a self-esteem instrument?

THANK YOU



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*Faculty of Computer Science
and Information Technology*

WOX7001 – RESEARCH METHODOLOGY

Topic 8 -Research Design

Agenda

01

GOOD VS BAD
DESIGN

02

DEVELOPING
THE STUDY
DESIGN

03

DESIGNING THE
RIGHT
INSTRUMENT

04

IMPLEMENTING
THE DESIGN

Poor design vs. Good design

◆ Well-designed study

Hit on an idea, do background research

Formulate relevant, specific, practical RQs

Consider participants, context, data analysis in advance

Decde/develop instrument; pilot and revise it

Decide on appropriate pre/post-test instruments

Plan stages and structure of data collection

Prepare participants adequately

...Then carry out the study

The importance of good design

A well-designed study provides many benefits:

- Demonstrates researcher knowledge
- Ties the study to an underlying philosophy
- Provides a clear path for the researcher(s)
- Helps avoid mishaps of previous studies

Approaching the study

- ❖ Step 1: Hitting upon research ideas
- ❖ Step 2: Review of the literature
- ❖ Step 3: Formulating research questions

Step 1: Hitting upon research ideas

- ❖ Identify the topic in a few words
- ❖ Reflect on “doability” of research
 - ❖ Can I research this?
 - ❖ Should I research this?
 - ❖ Am I interested in researching this?
- ❖ Review of the literature can help redefine and revise ideas

Step 1: Hitting upon research ideas

- ❖ Pose a short question using “what” or “how”
- ❖ Write a short title that consists of one sentence under 12 words
- ❖ Ask a friend or colleague to read your topic and gauge their reactions
- ❖ Draft research questions to see if the topic can be adequately explored

Step 1: Hitting upon research ideas

A “researchable” topic

- ❖ “Can I do this in my current situation?”
- ❖ “Does this concern people at other institutions?”
- ❖ “Does this add to the current body of research related to this topic?”
- ❖ “Does this study contribute something from a unique perspective?”

Step 1: Hitting upon research ideas

Filtering ideas: A few hints

- ❖ Review research designs and statistical techniques
- ❖ Review teaching methods and overall SLA research results
- ❖ Evaluate access to potential study participants
- ❖ Plan time for material creation, study design, and implementation

Step 2: Reviewing the literature

- ❖ Relate the study to continuing “dialogue” in current research
- ❖ Finding a “gap” in the literature
- ❖ Provide a framework for the importance of the study

Step 2: Reviewing the literature Finding a “gap” in knowledge

- ❖ “We do not enough about X...”
- ❖ “This way of looking at X has never been done...”
- ❖ “This way of learning about X has not been duplicated in my context”
- ❖ “Previous research has inadequately explored X...”

Step 3: Research Questions

A few useful guidelines

- ❖ Naturally flow from the literature review
- ❖ Strongly connected to the topic
- ❖ At least two or three (not one)...
- ❖ ...but not five or six or more
- ❖ As specific as possible
- ❖ Directly concern variables in the study
- ❖ Do not contain yes/no question words

Step 3: Research Questions

RQs: What not to ask

- ❖ “Is X true/false?”
- ❖ “Will X happen if...?”
- ❖ “Does X cause Y?”
- ❖ “What do participants think of X?”
- ❖ “Why does X happen?”

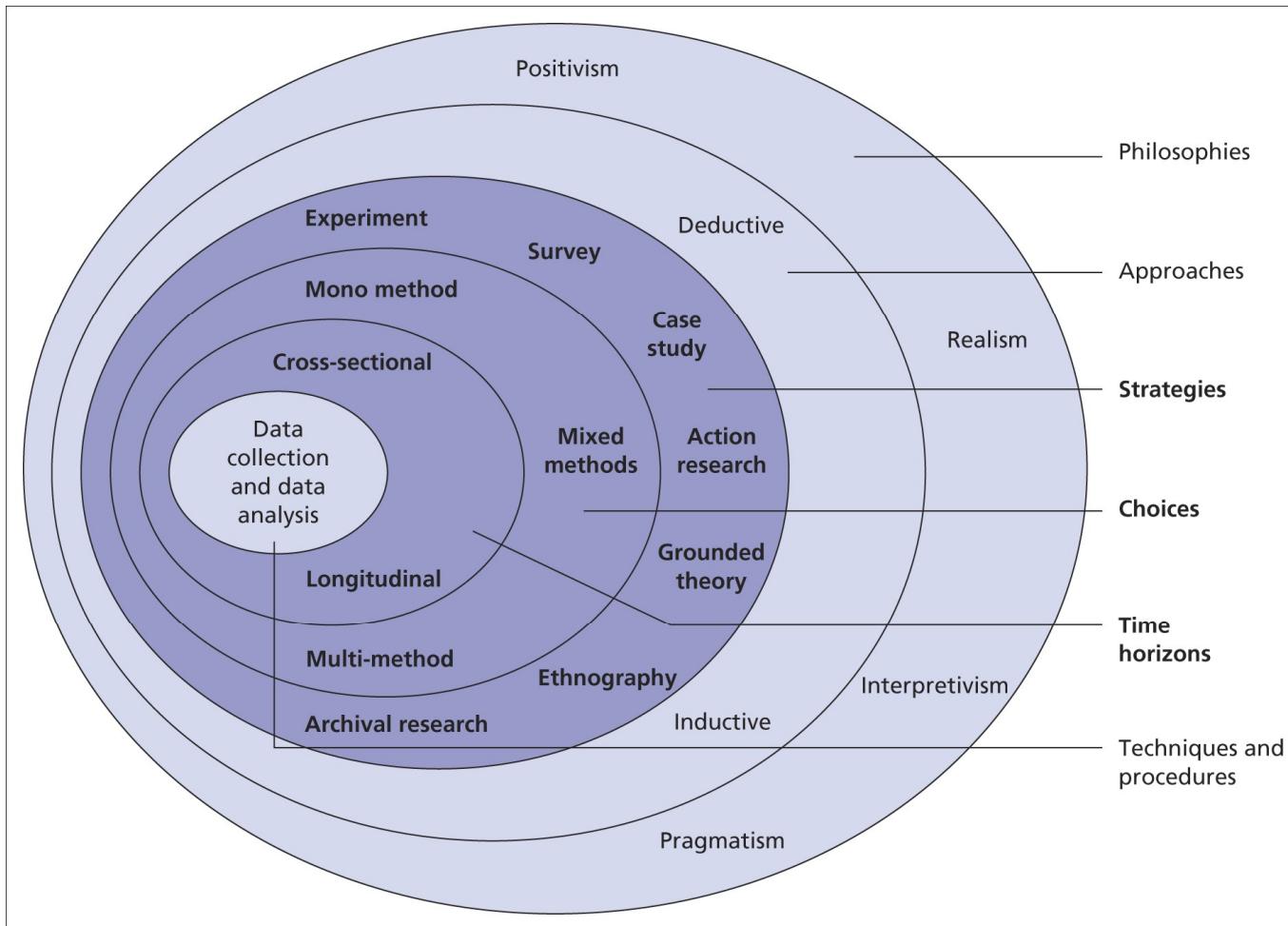
Step 3: Research Questions

RQs: What to ask

- ❖ “What differences exist between...”
- ❖ “Compared to X, how does Y...?”
- ❖ “To what degree do X and Y differ...?”
- ❖ “When X is controlled for Y..., how does Z...?”
- ❖ “What are underlying patterns among...?”
- ❖ “To what degree does X predict Y?”

Developing the Study Design

Research Design and Tactics



Research design

- ❖ Cross-sectional design: A design in which data are collected from a sample at only one point in time.
- ❖ Longitudinal design: A design in which data are collected at more than one point in time.

Randomized Control-Group Pretest-Posttest Design

Experimental Group 1	T1	Xa (Method a)	T2
Experimental Group 2	T1	Xb (Method b)	T2
Control Group	T1		T2

Randomized Control-Group Pretest-Posttest Design

- ❖ Reasonably strong conclusions can be reached about the effects of the treatments.
- ❖ Problem 1: Within session variation (e.g., different teachers or room conditions) may intervene.
- ❖ The solution? Randomly assigning participants, times, and places to the experimental and control conditions.
- ❖ Problem 2: The pretest may interact with the treatment. This potential problem is dealt with in the next design.

Randomized Solomon Six-Group Design

Pretested (Random assignment)	T1	Xa (Method a)	T2
Pretested (Random assignment)	T1	Xb (Method b)	T2
Pretested (Random assignment)	T1		T2
Unpretested (Random assignment)		Xa (Method a)	T2
Unpretested (Random assignment)		Xb (Method b)	T2
Unpretested (Random assignment)			T2

Randomized Solomon Six-Group Design

- ❖ This design amounts to doing the experiment twice –once with and once without pretesting.
- ❖ It is possible to know what effects, if any, are associated with pretesting.
- ❖ If the results of the “two experiments” are consistent, greater confidence can be placed in the findings.

Counterbalanced Design

- ❖ This design is useful when randomization is not possible and intact groups must be used.

Counterbalanced design

- ❖ The counterbalanced design rotates out the participants' differences (e.g., one group has more aptitude or motivation than the other groups) by exposing each group to all variations of the treatment.
- ❖ Order-of-presentation effects are controlled.
- ❖ Primary weakness: The possibility of carryover effects from one treatment to the next exists. Allowing time between treatments can alleviate this problem.

Control-Group Time-Series Design

- ❖ This design allows the researcher to determine growth over time, and the effect of an intervention.

- ❖ The presence of a control group increases the trustworthiness of the results because the possibility of a contemporary event causing any gains can be determined.

Control-Group Time-Series Design

- ❖ This design can be extended by exposing the participants to the intervention on multiple occasions.
- ❖ This approach is more sensitive to partial gains in knowledge and tests the strength of the intervention more than once, thus giving the researcher a more accurate understanding of the effectiveness of the intervention.

❖ Experimental Group 1	T1 T2	Xa T3 T4 Xa T5 T6
❖ Experimental Group 2	T1 T2	Xb T3 T4 Xb T5 T6
❖ Control Group	T1 T2	T3 T4 T5 T6

Designing the Right Instrument

Instrument Design

- ❖ Scored tests
- ❖ Rater scores
- ❖ Surveys
- ❖ Interviews

Instruments - Scored tests

Pluses

- ❖ Quantitative items (M/C, Cloze/C-tests)
 - ❖ Simple to score large # of participants
 - ❖ Easier to analyze

- ❖ Qualitative items (short answer, timed essays)
 - ❖ Good complement to quantitative scores
 - ❖ Can provide more in-depth assessment of participants' abilities

Minuses

Quantitative items
Limited to one type of data

Qualitative items

Take more time/effort to score
Rater bias

Instruments – Performance ratings

- ❖ An assessment of participants' performance in an assigned task
- ❖ Tasks may include presentations, interviews, written essays
- ❖ Performances can be scored using a Likert-scale, a rubric, or holistically
- ❖ Usually scored by at least two “expert” raters; sometimes also by peers

Instruments - Surveys

- ❖ Often used for:
 - ❖ Collecting learner history data (L2 study experience, other background info)
 - ❖ Assessing participants' attitudes towards a predetermined construct (language learning motivation, anxiety using the L2)
 - ❖ Determining reactions to an experimental treatment (teaching methods, innovative learning tasks)

Instruments - Interviews

- ❖ Interviews can provide an excellent qualitative component to a larger study
- ❖ It is not necessary to interview all participants
 - ❖ a subsample as small as 10-20% can be acceptable
- ❖ Use your best judgment on participants' language ability
 - ❖ For intermediate-and-above learners, L2 interviews are often fine

Instrument Validity

- ❖ The construct = The heart of the matter
- ❖ What construct do you wish to measure?
- ❖ How do you define the construct?
- ❖ What are its component parts? Do they form a unified whole?

IMPLEMENTING THE DESIGN

Including other researchers in the study

- ❖ The nature of the researchers involved
 - ❖ Main researcher plus “helpers”
 - ❖ One researcher plus “other participants”
- ❖ The nature of the instructors involved
 - ❖ Teaching methods
 - ❖ Students taught
 - ❖ Course goals
 - ❖ University program goals

Heading off potential problems

- ◊ Explain study commitments prior to starting the study
- ◊ Agree on “ownership” prior to data collection and data entry
 - ◊ Who will keep the data?
 - ◊ Whose name comes first, second, etc.?
- ◊ Keep everyone aware of deadlines
- ◊ Include everyone in decision-making processes and data analysis

Practical Issues

- ◊ Timing of implementation
- ◊ Learning and research context
- ◊ Participant consent
- ◊ Financial considerations

Timing of the implementation

- ◊ Beginning, middle, or end of semester
- ◊ Day of the week
- ◊ Time of day
- ◊ Exams and exam preparation periods
- ◊ “Culture Festivals” or other club-related events
- ◊ “Open classes” or “parents’ day”

Learning and research context

- ❖ Differing course goals (I.e., listening class vs. reading class)
- ❖ Different major field of study
- ❖ Gender, age, year in school
- ❖ Number of class meetings
- ❖ Perception of the value of research by institution heads

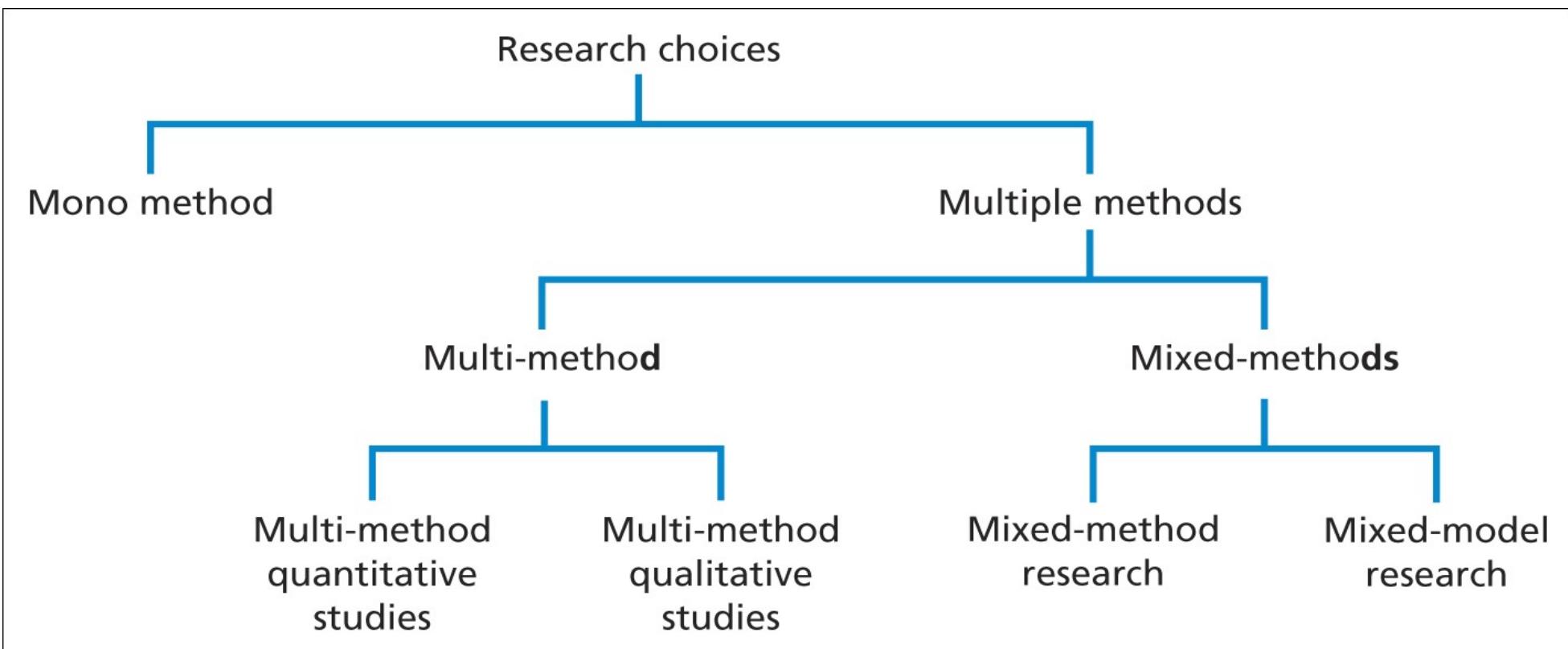
Participant consent

- ❖ Always allow for “non-participation” choice from potential participants
- ❖ Write clear instructions for participants asking for their cooperation
- ❖ Ask co-researchers or helpers to briefly inform participants about their choice

Financial considerations

- ◊ Copies for questionnaires, exams, etc.
- ◊ Computer analysis software
- ◊ Mailing costs
- ◊ Interview travel costs
- ◊ Recording equipment
- ◊ Reference books
- ◊ Journal article costs

Research choices



THANK YOU

WOX7001 - RESEARCH METHODOLOGY

Topic 9 - Ethical Issues

Agenda

01

GENERAL
ETHICS
PRINCIPLES

02

AREAS OF
DISHONESTY

03

ETHICAL
GUIDANCE AND
EXAMPLE

Definition of Scientific Misconduct

Scientific misconduct is fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results.

Basics of Ethics in Research

- ❖ Dishonest, fraudulent, or unethical researchers can circumvent the scientific method

Example of Misconduct in Research. The Tuskegee Syphilis Study

- ❖ Was investigation of long-term effects of untreated syphilis on AA males in Macon County, AL
- ❖ Decision was made to do long-term prospective study and follow long-term effects until death
- ❖ Participants were never told real nature of study – were not afforded informed consent
- ❖ Treatment for syphilis was withheld (even after discovery of penicillin to treat syphilis) – study continued for 40 yrs.

Regulation of Research and Protection of Research Participants

- ❖ Proponents of situational ethics argue that no general rules can be applied to all situations – each action is unique
- ❖ Belmont report – serves as a fundamental document for current federal regulations for protection of human subjects – 3 principle:
 1. Respect for Persons
 2. Beneficence
 3. Justice
- ❖ Code requires that protocols involving human subjects be reviewed by an IRB.

<http://www.ohrp.osophs.dhhs.gov/humansubjects/guidance/belmont.htm>

Informed Consent

❖ Inherent to this principle are 4 elements:

1. Subjects are made fully aware of the nature and purpose of the research project
2. Consent is voluntarily given
3. The person involved has the legal capacity to give consent
4. The responsibility for obtaining consent rests with the researcher

Privacy and Confidentiality

- ❖ Privacy refers to capacity of individuals to control when and what conditions others have access to their behaviors, beliefs, and values.
- ❖ Confidentiality refers to linking information to a person's identity
- ❖ Informed consent should indicate how researcher will protect confidentiality of participants

Privacy and Confidentiality

- ❖ Some procedures that can ensure confidentiality:
 - ❖ Obtaining anonymous information
 - ❖ Code data so that identifying info is eliminated
 - ❖ Substitute other names
 - ❖ Do not release or report individual data
 - ❖ Limit access that could reveal individual identity
 - ❖ Report data only in group form
 - ❖ Used computerized methods for encrypting data

Areas of dishonesty

Prepared by: HSM, NAG and SUH

Areas of Dishonesty

1. Plagiarism—using the ideas, writings, and drawings of others as your own
2. Fabrication and falsification—making up or altering data
3. Nonpublication of data , also called “cooking data”
4. Faulty data-gathering procedures
5. Poor data storage and retention

Areas of Dishonesty

6. Misleading authorship—who should be an author?
 - Technicians do not necessarily become joint authors.
 - Authorship should involve only those who contribute directly.
 - Discuss authorship before the project!

1. Plagiarism

- ❖ Means using ideas, writings, or drawings of others as your own.
- ❖ Happens with student work as well – with advent of Internet, the availability of research is greater – is often more tempting
 - ❖ Can occur unintentionally with students and researchers if they are careless or nonsystematic about their “pre-writing” and revision to a paper/manuscript
- ❖ Common practice is to circulate drafts of papers among scholars who are known to be working in a specific area – give credit where credit is due.

2. Fabrication and Falsification

- ❖ Occasionally, scientists will be caught “making up” research –
 - ❖ Technical term is called “Cooking the data”
 - ❖ “I only need a few more subjects, but I am running out of time.”
 - ❖ Falsification can also occur with cited literature –
 - ❖ Be careful how you are interpreting what an author says – “If it ain’t there, don’t make it up out of thin air”.
 - ❖ Is another reason you should rely primarily on primary, original sources.

3. Nonpublication of Data

- ❖ This refers to “not including” data because they don’t support the hypothesis
- ❖ Sometimes in the data, there are extreme scores or “outliers” - and these outliers are “trimmed” from the data set
- ❖ They can result in non significant findings but should “automatically” be cut.
- ❖ Non significant results often give just as much important information as do significant results.

4. Faulty Data Gathering

- ❖ Aspects that students should be aware of:
 1. Continuing with data collection from participants who are not meeting the requirement of the research EXAMPLES: Subject comes in with a hangover and you use that data anyway
 2. Malfunctioning equipment
 3. Inappropriate treatment of subjects
 4. Recording data incorrectly

5. Poor data storage and misleading authorship

Poor Data Storage –

- ◊ Rule of thumb is to keep data for 3 years
- ◊ All original data should be kept if there is a question

5. Poor data storage and misleading authorship

Misleading Authorship –

- ❖ Order of authorship is based on author's contributions
- ❖ 1st author usually developed the idea for the research
- ❖ This needs to be decided BEFORE the research is started.
- ❖ Two rules help to define authorship:
 1. Technicians are not necessarily authors
 - ☞ Data collectors are not necessarily included in the authorship
 2. Authorship SHOULD include only those who directly contribute

GUIDANCE and EXAMPLE

Prepared by: HSM, NAG and SUH

ETHICAL ISSUE REGARDING COPYRIGHT

- What is “fair use” of materials?
 - Purpose: Commercial or educational?
 - Nature: Is copying expected?
 - Amount: How much is copied?
 - Effect: What is the influence on the market?
- For teaching: Articles, chapters, overheads, slides, PowerPoint presentations
- For research: Figures and tables, standardized tests, questionnaires, previously published scholarly work
- If you are unsure, *ask permission!*

EXAMPLE: Plagiarism

In preparing her thesis introduction, Graduate Assistant Christina periodically takes multiple sentences verbatim from some of her sources (her attitude is, “I couldn’t have written it better myself”).

- Is she wrong to do this?
- If she provides a reference to her sources at the end of the paragraph, is she still wrong?

EXAMPLE: Fabrication and Falsification of Data

Professor Wade has strength-training data on 20 elderly participants. As he was madly processing his data to meet the ACSM abstract deadline, he realized that the sample did not show a significant increase in strength. Examining his data more closely revealed that 15 participants did improve, but 5 did not. He decided that they must not have adhered to the training, so he dropped them and now has a significant increase in strength.

EXAMPLE: Fabrication and Falsification of Data

- Has Professor Wade acted ethically?
- How long should you keep your data for others to see?
- Are you obligated to provide your data on request?

THANK YOU