CST 395-2

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Research Methodology & Scientific Writing

Introduction to Research Methodology

Lesson 01

Learning Outcomes

- Upon successfully completing this lesson, you will be able to:
  - Describe what is a research and its significance.
  - Explain the fundamental concepts of research methodology and its basic principles.
  - Describe research paradigms to analyze and evaluate different approaches to conducting research.
  - Differentiate between qualitative and quantitative research methods.
  - Apply strategies for generating research ideas and selecting a research topic aligned with personal interests, current trends, and societal needs.
  - Describe fundamental research ethics principles, including honesty, integrity, and respect for participants' rights and welfare.

Lesson Outline

- Research and Importance of Research
- Research Methodology and Its Basics
- Research Paradigms
- Qualitative vs. Quantitative Research
- Finding a Research Topic
- Research Ethics Principles

Research: What is It?

- A systematic approach of gathering and analyzing information to find answers to questions or to address specific problems
- It's not just random browsing or information gathering
- Follows a structured approach to ensure the findings are reliable and unbiased
- Involves careful planning, data collection, analysis, and interpretation to generate new knowledge or insights
- The ultimate goal of research is to add to the existing body of knowledge and improve understanding of a subject
- Examples:
  - Development of a Machine Learning-Based Intrusion Detection System for Network Security
  - Social Media Analytics for Understanding Public Sentiment Towards the Next President of Sri Lanka

Research: Types

- Scientific Research
  - Scientists do careful experiments or observations to learn new things about the natural world
  - They test ideas, collect data, and analyze it to find out how things work or why things happen
- Social Science Research:
  - People study how humans behave and interact with each other in society
  - Use methods like surveys, interviews, and watching people to understand things like how societies work, why people act the way they do, or how cultures change over time
- Historical Research:
  - Dig into the past to find out what happened and why
  - Look at old documents, artifacts, and stories to piece together stories about people, events, and cultures from long ago.
  - Help us understand how the past has shaped the present

Research: Why is it Important?

- Research is like exploring, problem-solving, creating cool things, helping ones to make good decisions, staying smart, and keeping our history alive
  - Helps us find out more about the world we live in, like how things work, why things happen, and what's out there beyond what we already know
  - Helps to solve problems
  - Leads to new inventions and ideas that make life easier or more fun
  - Helps to make decision easier
  - Helps us understand where we come from and why things are the way they are by studying old stuff, like ancient buildings, traditions, and stories

Research Methodology: What is It?

- The roadmap for your research project
- Outlines the practical steps you'll take to answer your research questions and ensures your findings are reliable
- Can define it as,

  "**A systematic approach and techniques used to conduct research and gather information to answer a research question or achieve research objectives**"
- Typically having following key components
  - Research Design: Decide what to study and what questions to answer
  - Data Collection Methods: Gather information or data
  - Sampling: Pick who or what you're going to study
  - Data Analysis: Find patterns or answers to your questions
  - Validity and Reliability: Making sure the research finding are accurate and reliable; simply, whether these finding are trustworthy
  - Ethical Considerations: Doing things the right way; being fair and honest; respect

Research Methodology: It's Basics

- **Formulating the research problem or problem statement**
  - Foundation of the entire project
  - Statement that describes the specific issue or question that the research aims to address
  - Typically arises from an identified gap in existing knowledge or understanding within a particular field or topic of study
  - Should be clear, specific, and feasible to answer within the available resources
- **Formulating the research aim**
  - Broad statement that captures the overall goal of your research
  - Outlines what you hope to achieve by the end of your project
  - Guide the development of more specific objectives and questions
- **Formulating the research objectives**
  - More specific and measurable statements that break down the research aim into smaller, achievable steps
  - Clarify how you will reach the overall goal of your research

Research Methodology: It's Basics

- **Formulating specific research questions**
  - Dive deeper into the research objectives
  - Guide your data collection and analysis
  - Provide a clear direction for your investigation
- **Hypothesis**
  - A specific, testable statement about the relationship between two or more variables
  - An educated guess about what you expect to happen during your experiment or study
  - Based on your existing knowledge, background research, and understanding of the topic you're investigating
  - Not all research projects involve a hypothesis

Research Methodology: It's Basics

- **Choosing a research design**
  - Blueprint for how to conduct the research
  - Different types of designs, each suited for different purposes
  - Common ones:
    - Experimental – Tests a cause-and-effect relationship by manipulating variables
    - Survey – Gathers information from a large group of people through questionnaires
    - Observational – Studies a phenomenon without manipulating variables
    - Case study – Explores a single case in detail to gain in-depth understanding
  - Selecting the appropriate research design is crucial as it determines how data will be collected, analyzed, and interpreted

Research Methodology: It's Basics

- **Data collection methods**
  - Determines how you'll gather the information you need
  - Some common methods:
    - Surveys: Questionnaires or interviews to collect data from a sample population.
    - Experiments: Manipulating variables and observing the results.
    - Observation: Systematically watching and recording behavior or phenomena.
    - Existing data: Analyzing data already collected by others.
- **Data analysis**
  - Once you have data, you need to make sense of it
  - This might involve statistical analysis for quantitative data (numbers) or qualitative coding for non-numerical data (text, interviews)

Research Methodology: It's Basics

- **Validity and Reliability**
  - Validity
    - Are you getting the right answer to your research problem and questions?
    - Whether your research is actually measuring what it's intended to measure
  - Reliability
    - The consistency of your research findings
    - Ensuring your findings are not just random or due to chance
  - Combination of validity and reliability makes the research findings trustworthy and allows other researchers to build upon them
- **Ethical considerations**
  - Research should be conducted ethically; be honest; respect participants
  - This means protecting the privacy of participants, obtaining informed consent, and avoiding any harm

Research Paradigms

- A broad framework or perspective that guides how researchers approach the study of phenomena and construct knowledge within a particular discipline or field of study
- Commonly four:
  - **Positivism**
    - Emphasizes an objective reality knowable through scientific methods
    - Prioritizes quantitative data and aims to produce generalizable findings
    - Believes that the world works like a big machine that can be measured and understood through scientific methods
    - All about finding facts and patterns that everyone can agree on
    - Example:
      - If you were studying how plants grow, you might measure their height and count their leaves to find out what makes them grow faster

Research Paradigms (Cont'd)

- **Interpretivism**
  - Focuses on understanding subjective meanings and experiences
  - Use qualitative data collection methods to gain rich, in-depth understanding of individual and social perspectives
  - Interested in understanding people's thoughts, feelings, and experiences
  - Looks for meanings and stories behind people's actions
  - Example:
    - If you were studying why some students love to attend lectures while others don't, you might talk to them and listen to their stories to understand their different perspectives

Research Paradigms (Cont'd)

- **Critical Theory**
  - Aims to expose inequalities and promote social change through qualitative research methods and critical analysis
  - All about questioning the current situation and trying to make the world a fairer place
  - Instead of just accepting things as they are, critical theory asks tough questions about power and privilege
  - Example:
    - If you were studying why some university students have more internship opportunities than others, you might look at how social systems like education and employment create unfair advantages for some groups

Research Paradigms (Cont'd)

- **Pragmatism**
  - Concerned with finding solutions to real-world problems
  - Utilizes a mixed-methods approach, combining quantitative and qualitative data collection for a more comprehensive understanding and practical outcomes
  - All about what works and what gets results
  - Example:
    - If you were studying how to improve healthcare in a community, you might use a mix of surveys to gather data from residents and interviews with healthcare providers to find practical ways to make healthcare better

Qualitative vs. Quantitative Research

- **Qualitative research**
  - Research which focuses on collecting and analyzing words (written or spoken) and textual or visual data
  - Used when the research aims and research questions are exploratory in nature
  - i.e., might be used to understand peoples' perceptions about an event that took place
- **Quantitative research**
  - Focuses on measurement and testing using numerical data
  - Used when the research aims and research questions are confirmatory in nature
- Mixed-method methodology attempts to combine the best of both qualitative and quantitative methodologies

Finding a Research Topic

- Identify your interests
  - Think about the areas that genuinely interest you from the given list
  - Consider your hobbies, passions, academic background, or any societal issues
  - Select an interesting domain if applicable for your field
- Use ChatGPT or other AI tools to explore a wide range of topics related to your interests after feeding the appropriate context
- Pick an interesting idea from the given list by the tool
- Use scholarly article search engines like Google Scholar and search about the idea
- Read a few recent articles published in the selected area
  - Focus mainly on the last two sections of the paper which mainly describe the future works or limitations they had there in their research
- Pick one interesting idea and explore more to fine-tune your topic

In-class Activity

- Follow the discussed steps about how to find a research topic and find at least one research topic for your group.

Post-class Activity

Mark Allocation: 10 Marks

- Every student must find a research topic and submit it to the Research Topics discussion forum available on the VLE course page from April 20, 2024.
- Please adhere to the following guidelines when you submit a research topic:
  - Group members who are within the group should select three different areas from the given list and submit their own topic.
  - Since one group has at least three members, one group should have at least three topics, and those topics must be from different areas.
  - Before adding your topic to the forum, check whether anyone else has the same idea.
  - Originality of the idea belongs to the student who published that topic first to the forum.
  - If anyone sees that a topic is duplicated, ask the student to remove it from the forum or put a comment there.
- This activity carries individual marks, so if the provided topics are appropriate to the above guidelines only, marks will be awarded.
  - For example, if one group suggested two topics from the same area, all the members of that group will lose marks for this activity.

Research Ethics Principles

- Respect for persons
  - Emphasizes the autonomy, dignity, and rights of research participants
- Maximize the potential benefits of the research and minimize potential risks
  - Evaluate the potential risks and benefits of the research and ensure the benefits outweigh the risks
- Ensures fairness and equity in research participation
  - Participants should be selected based on their relevance to the research question
- Scientific integrity – Honesty, transparency, and objectivity in conducting research
  - Must accurately report their findings and methods, avoiding fabrication or falsification of data
- Communicate their findings to the public and relevant stakeholders in a clear and responsible manner


QUESTIONS?