

Research Methodology in CSE, MTech-I (1st semester)

Chapter 1-2: Overview of Research Processes and Methodology

October 17, 2022



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Chapter 1: Topics of Study

- Introduction [DCJ]
 - What Is Research? Definition, Characteristics, Motivation and Objectives, Research Methods vs Methodology. Research as an integral part of professional practice. A way to gather evidence for practice. Evidence-based practice. Applications of research in practice. Development and policy formulation. [3 hours]
 - Overview of the research process: its characteristics and requirements. Types of research: Descriptive vs Analytical, Applied vs Fundamental. Research Designs: Quantitative vs Qualitative vs Mixed Methods Designs. Conceptual vs Empirical. [2 hours]
- Research Process & Methodology [DCJ]
 - The research process as an eight step model. Deciding what to research. Planning how to conduct the study. Conducting the research study. [1 hour]

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 - Approach for verification, specification,..

What now further?

- Here, we shall delve deeper into what is a research process, how to define it and what are its various taxonomies.

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 - is designed to be **unbiased and objective**.

Applications of Research

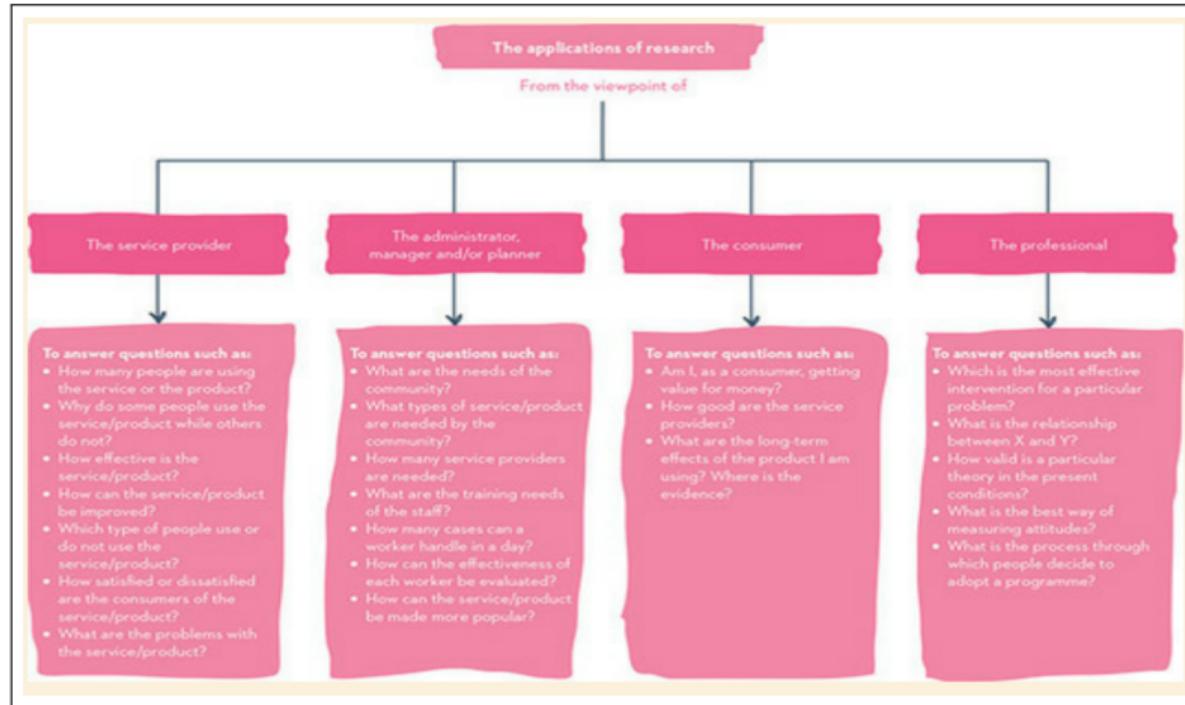


Figure: Applications of Research: The meaning of research differs amongst disciplines

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- these can be understood by analyzing the attributes of research.

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 - e.g. a psychologist may look at a piece of information differently than an anthropologist or a historian.
 - Bias, on the other hand, is a **deliberate attempt to either conceal or highlight something because of one's vested interest.**
- Therefore, when you say you are undertaking a research study to find the answer to a question, this implies that the method **you are adopting fulfils these expectations**

Bias: A deliberate attempt either to conceal or highlight something that you found in your research or to use deliberately a procedure or method that you know is not appropriate but will provide information that you are looking for because you have a vested interest in it.

Subjectivity: This is an integral part of your way of thinking that is 'conditioned' by your educational background, discipline, philosophy, experience and skills. Bias is a deliberate attempt to change or highlight something which in reality is not there but you do it because of your vested interest. Subjectivity is not deliberate, it is inherent in the way you understand or interpret something.

Figure 1.1 The applications of research

Figure: Bias vs Subjectivity

Tutorial #1: On Bias and Subjectivity

- To be defined

Characteristics of a research process

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- let us try to look at each characteristic in greater detail and with the help of an illustration each.

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 - later, we would see that the rigor in qualitative research is different from that in quantitative research in many ways.

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Type of rigor	Description	Researcher's intent	Outcomes
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Creative or crafty rigor	The researcher applies rigor where he wants to but does not apply it where there are some loopholes in research. For example, to prove the hypothesis true.	To purposefully mislead	Plagiarized research and criminal charges can apply depending on the extent of deceit.
Careless rigor	The researcher applies rigor to some part of the research but avoids on other areas because of carelessness.	To achieve desired results without real efforts	The research will most likely lack reliability and will not be valid
Careful rigor	The researcher carefully applies rigor to every part of research	To conduct ethical and scientific research	Reliable and valid research
Enduring rigor	The researcher carefully applies rigor to every part of research and repeats results to get enduring data.	To conduct reliable and valid research	Reliable, reproducible, and valid research

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- the table here shows some of the ways in which the researcher can deceive the readers by introducing false rigor in his/her research.

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The screenshot shows a journal article from the journal "COMMUNICATIONS PHYSICS". The title of the article is "Creating an executable paper is a journey through Open Science" by Jana Lasser. The article discusses the concept of executable papers and their role in open science. It highlights the transparency and reproducibility of research results. The article is available at <https://doi.org/10.1038/s42005-020-00403-4>.

COMMENT
<https://doi.org/10.1038/s42005-020-00403-4> OPEN

Creating an executable paper is a journey through Open Science

Jana Lasser^{1,2✉}

Executable papers take transparency and openness in research communication one step further. In this comment, an early career researcher reports her experience of creating an executable paper as a journey through Open Science.

Open Science practices are taking an increasingly central role in the way we conduct research, from accessible research data to transparency in the methodologies used to analyze them. To this end, the novel “executable paper” format offers a transparent and reproducible way to communicate research. Executable papers are pieces of software that combine text, raw data, and the code used for the analysis, and that a reader can interact with. In this commentary, I introduce the executable paper format and highlight its advantages for research communication. Drawing from my personal experience, I offer practical advice on how to create an executable paper by using Open Source tools such as Python and Jupyter Notebooks, and how to make it accessible by publishing it on open repositories.

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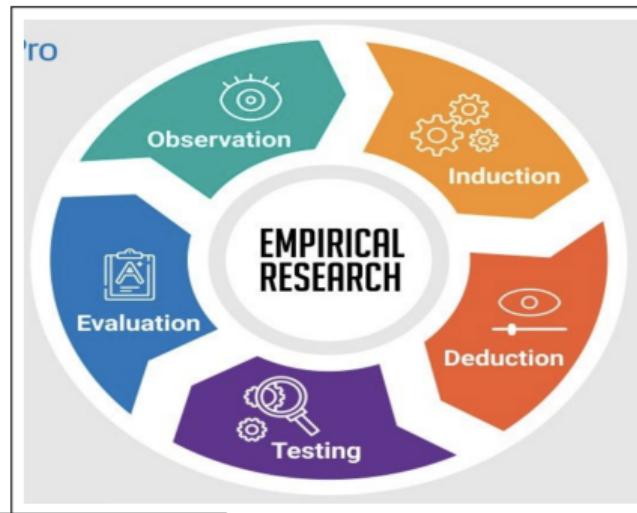
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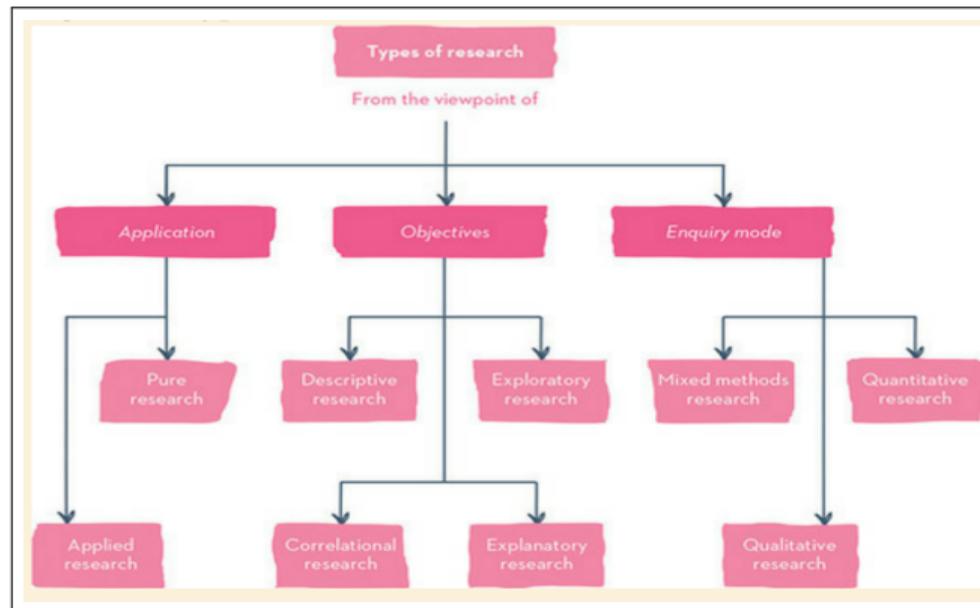


Figure: Types of Research

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Categories of Research	Types of Research
Types of research according to the application perspective	<ul style="list-style-type: none">Basic researchApplied Research
Types of research according to the aims of the research	<ul style="list-style-type: none">Descriptive researchExplanatoryAnalytical research
Types of research according to the mode of inquiry	<ul style="list-style-type: none">Quantitative researchQualitative research
Types of research according to the aims of the research approach	<ul style="list-style-type: none">Longitudinal researchCross-sectional researchConceptual researchEmpirical research

Figure: Types of Research: Another View

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- involves developing and testing theories and hypotheses that are intellectually challenging to the researcher but may or may not have practical application at the present time or in the future.

Types of research: Applications Perspective : Basic research...

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Types of research from the perspective of application.....Applied research

- is conducted to find solutions for practical problems.
- uses the outcomes of basic research as its base.
- The results of applied research are applied immediately.
- includes case studies, experimental research.
- e.g.
 - **fast and energy efficient** neighbor discovery problem in WSNs
 - Finding the solution to control air pollution.
- An interesting observation in Provost et al ¹
 - *often, problems that arise in the applications cast light on insufficiencies in previous research results. Subsequent applied research proposes and implements ad hoc solutions to the problems. These solutions then move further toward the academic end of the spectrum gaining generality and losing the simultaneous focus on a variety of problematic issues that characterize applications work.*
- Tutorial Assignment: Discussion on the paper in class.

¹Provost, F., Kohavi, R. Guest Editors' Introduction: On Applied Research in Machine Learning. *Machine Learning* 30, 127–132 (1998).

Types of research: Aims OR Objectives Perspective

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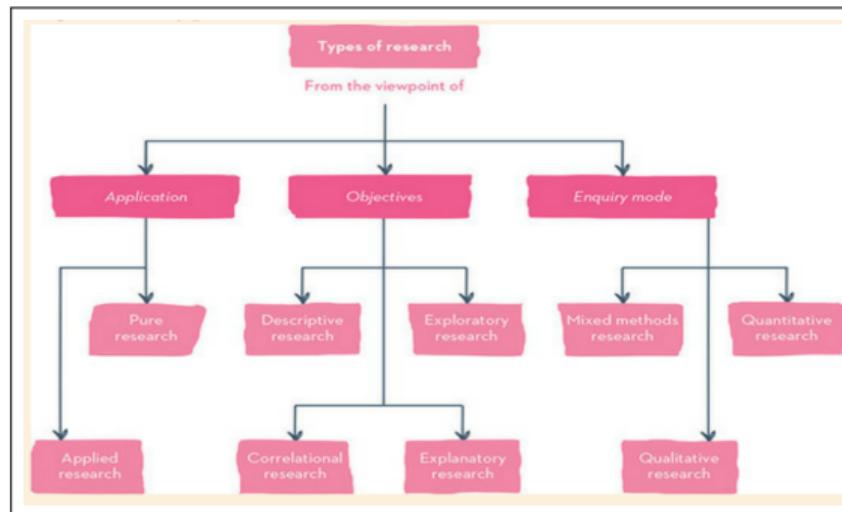


Figure: Types of Research

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- lastly, is the structured approach to enquiry as against the qualitative approach, which is the un-structured approach.

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 - if one wants to find out the different perspectives on an issue or the problems experienced by people living in a community, then these are better explored by using unstructured enquiries.
- Thus, if one needs to look into **all of these aspects**, one may have to use both approaches; that is, use the mixed methods approach.

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- the mixed methods approach could be either entirely quantitative or qualitative or some sections could be qualitative and some quantitative.

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 - is also dependent upon some other considerations - these are shown partially in the table next.

Types of research: Mode of enquiry Perspective approaches distinctions

Difference with respect to:	Quantitative approach	Qualitative approach	Mixed methods approach
Underpinning philosophy	Rationalism: 'That human beings achieve knowledge because of their capacity to reason' (Bernard 1994: 2)	Empiricism: 'The only knowledge that human beings acquire is from sensory experiences' (Bernard 1994: 2)	Both are valuable to social research theory and practice. That knowledge can be gained through both the capacity to reason and sensory experiences.
Approach to enquiry	Structured/rigid/predetermined methodology	Unstructured/flexible/open methodology	Can be structured, unstructured or both
Main purpose of investigation	To quantify the extent of variation in a phenomenon, situation, issue, etc.	To describe variation in a phenomenon, situation, issue, etc.	To quantify and/or explore with multiple or mixed methods a phenomenon to enhance accuracy or yield greater depth
Measurement of variables	Emphasis on some form of either measurement or classification of variables	Emphasis on description of variables	Measurement and/or description
Sample size	Emphasis on greater sample size	Fewer cases	Larger sample size for some aspects and smaller for others, depending upon the purpose
Focus of enquiry	Narrows focus in terms of extent of enquiry, but assembles required information from a greater number of respondents/sources	Covers multiple issues but assembles required information from fewer respondents	Narrow or broad, or both, depending upon the methods used
Dominant research topic	Explains prevalence, incidence, extent, nature of issues, opinions and attitude; discovers regularities and formulates theories	Explores experiences, meanings, perceptions and feelings	Both or either, depending upon the methods used
Analysis of data	Subjects variables to frequency distributions, cross-tabulations or other statistical procedures	Subjects responses, narratives or observational data to identification of themes and describes these	Quantitative or qualitative or both, depending upon the objectives
Dominant research value	Reliability and objectivity (value-free)	Authenticity; but does not claim to be value-free	Dominant value of one or both of the paradigms
Communication of findings	Organisation more analytical in nature, drawing inferences and conclusions, and testing magnitude and strength of a relationship	Organisation more descriptive and narrative in nature	Similar to the quantitative and/or qualitative approach

Figure: Qualitative, Quantitative and Mix-mode research

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Tutorial Assignments

- To be written

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- C

The research process as an eight step model.

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