Research Methodology

MTech (CSE) – Aug-Dec 2022

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Why Research?

- Research is more formalized and has become an integral part of both the academic institutions imparting higher education and institutions created for research
- Besides the self-satisfying aspect of the act of research and dissemination of the new information to others under the ownership of researcher(s), the research output is also a major factor for assessing the competence and achievements of an individual, groups of individuals or an institution!!!

Introduction

- Research methodology is **a way of explaining how a researcher intends to carry out their research**. It's a logical, systematic plan to resolve a research problem.
- Data may be grouped into four main types based on methods for collection: **observational, experimental, simulation, and derived**.

More definitions

- **The techniques or the specific procedure which helps the students to identify, choose, process, and analyze information about a subject** is called Research Methodology.
- It allows the readers to evaluate the validity and reliability of the study

More definitions

- Research methods are specific procedures for collecting and analyzing data.
- Your methods depend on what type of data you need to answer your research question:
- **Qualitative vs. quantitative**: Will your data take the form of words or numbers?
- **Primary vs. secondary**: Will you collect original data yourself, or will you use data that has already been collected by someone else?
- **Descriptive vs. experimental**: Will you take measurements of something as it is, or will you perform an experiment?

Case study: Autonomous cars

- Basics
- Advocates
- Critics
- Technology readiness
- Point of view: Safety
- Street Dog, Owner, Driver, Passenger, Manufacturer, Insurance co., RTO
- Decision making: Accident scenario

Curriculum (part)

- Formulating a research problem & Literature Review: Reviewing the literature.
- The place of the literature review in research Bringing clarity and focus to research problem. Improving research methodology. Broadening knowledge base in research area. Contextualising findings.
- Difference between a literature review and a summary of the literature.
- How to review the literature Searching for the existing literature. Reviewing the selected literature. Developing a theoretical framework.
- Developing a conceptual framework

Curriculum (part)

- Writing about the literature reviewed. Abstracting Studies. Examples.
- What makes a good research question? The research problem. The importance of formulating a research problem. Sources of research problems. Considerations in selecting a research problem. Steps in formulating a research problem.
- The formulation of research objectives. The study population. Establishing operational definitions. Formulating a research problem in qualitative research.
- Writing Research papers. Steps. The importance of outline. Writing Abstracts and Introduction sections. Writing Conclusions.

More on data

- For quantitative data, you can use statistical analysis methods to test relationships between variables.
- For qualitative data, you can use methods such as thematic analysis to interpret patterns and meanings in the data.

Case Study: British Design v/s Japanese

- Storage Water Heater – Bathroom
- Functionality – to provide warm/hot water for bathing
- British way – best sensor, high accuracy precision display, remote for setting and control, robust relay (long lifetime), etc. etc.
- Temperature - discrete variable - Accuracy – 3 digits
- Temp - 10.000 to 100.000 degree centigrade (110000 values)
- Display – same accuracy
- Controller – very complicated

Case Study: British Design v/s Japanese (cont.)

- Japanese way
- Temperature - fuzzy variable - Accuracy – very good
- Temp - 10.000 to 100.000 degree centigrade (5 zones – cold (say -10 to 25 degree centigrade), normal (20-30), warm (28-36), hot (35-48), very hot(42-100)
- Overlapping zones (fuzzification – relay is not strained)
- Display – same accuracy – zones
- Controller – very simple

Qualitative analysis methods

- Qualitative analysis is used to understand words, ideas, and experiences. You can use it to interpret data that was collected:
- From open-ended survey and interview questions, literature reviews, case studies, and other sources that use text rather than numbers.
- Using non-probability sampling methods.
- Qualitative analysis tends to be quite flexible and relies on the researcher's judgement (subjective)

Subjective (Example)

- Good for some one is Bad for other
- E.g. Member of Political parties - giving opinion about new projects, governance
- E.g. Fan base of cricketer – criticizing other cricketer
- Sample size and diversity of subjects are important
- What is Trustworthy?

Quantitative analysis methods

- Quantitative analysis uses numbers and statistics to understand frequencies, averages and correlations (in descriptive studies) or cause-and-effect relationships (in experiments).
- You can use quantitative analysis to interpret data that was collected either:
- During an experiment or Using probability sampling methods
- Because the data is collected and analyzed in a statistically valid way, the results of quantitative analysis can be easily standardized and shared among researchers.

Crowd sourcing (example)

- Going to Kobe sizzlers (drop to Yoko sizzlers)
- UBER
- Google maps/Google Geo
- Crowd verification
- Reputation system
- Correcting the issue (by approaching Google Geo – raise a ticket with proof(s))
- Sample size and sample diversity (weight??)