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THESIS WRITING

The T, H, E, S, I, S Approach



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Foreword
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JAYPEE

CONTENTS

1. **Role and Importance of Thesis in Postgraduate Training** 1
   BV Adkoli

2. **Research: Basic Concepts** 18
   Kapil Gupta

3. **Research Designs** 41
   Parag Chavda

4. **Starting Research** 60
   Shyam Mehra

5. **Aim and Objectives** 77
   Tanvir Kaur Sidhu

6. **Review of Literature** 90
   Sahiba Kukreja

7. **Writing A Synopsis** 105
   Anshu

8. **Material and Methods** 125
   Purvi Bhagat

9. **Sample Size** 139
   Jaykaran Charan

10. **Results and Inference** 153
    Juhi Kalra

11. **Managing Timeline** 176
    Shaista Saiyad, Rajiv Mahajan

12. Ethical Issues in Thesis Research **190**
Jugesh Chhatwal, Gagandeep Kwatra

13. Basic Statistics and Tests of Significance **208**
Abhishek V Raut, Subodh S Gupta

14. Introduction to SPSS **225**
Shital Bhandary

15. Compilation of Thesis Work **255**
Anil Kapoor

16. Handling Revisions **270**
Gagandeep Kwatra, Jugesh Chhatwal

17. Manuscript-based Thesis **279**
Purvi Bhagat

18. Disseminating Thesis Research: Preparing a Quality Poster **292**
Medha A Joshi

19. Disseminating Thesis Research: Publication of Paper **308**
Purvi Bhagat, Rajiv Mahajan, Tejinder Singh

20. Translational Education Research **323**
Amrit Virk

Appendices ***339***

Index ***349***

CHAPTER 2

Research: Basic Concepts

Kapil Gupta

Key Points

- Research is orderly and systematic process; carrying it in sequential manner ensures its reproducibility.
- Research process is iterative and flexible in nature.
- The research problem and research objectives define the subsequent steps of research.
- Appropriate research design is the key to successful scientific papers and publications.

TICKLING

All research is not destined for a 'Nobel Prize'—rather much of it is to train the postgraduate (PG) students in data collection, synthesis, and analysis. At the same time, it should not be transference of bones from one graveyard to another. However, we cannot ignore the fact that prosperity of nation always depends upon attitude toward research and its use in production. There exists a close relationship between health services of nation and medical research programs run by medical research centers to produce, evaluate, adopt, and distribute new approaches as well as to train the scientists for use of innovative approaches (Singh and Singh, 1993).

Having understood the importance of thesis research in PG training in previous chapter, you all must be very excited to initiate your thesis work. In subsequent chapters, we will take you through

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the journey of conduct of thesis research, in a stepwise manner, but before that, let us discuss some basic aspects of research in general and thesis research specifically.

First question that comes to our mind is—What exactly is Research? It is the process of gathering information for the purpose of identifying, initiating, and modifying a question. It is carried in a careful and detailed manner using the scientific method with the intention to answer the question, which may be a specific problem, issue or a current concern. As defined by American sociologist Earl Robert Babbie "*Research is defined as a systematic inquiry to describe, explain, predict, and control the observed phenomenon*". You can answer questions like "What", "Where", "Why is", "How does", "When", "How Much", and "How Often" only through research.

The need for research is varied; you can do it to gain familiarity with a phenomenon or to achieve new insight into it, describe a health-related event, test the hypothesis of association, develop new drugs or to refine and eliminate old knowledge. Research may be basic or applied, problem oriented or problem solving and qualitative or quantitative; however, each type of research will be unique because of difference in time, settings, design, methodology, and place. So, whenever you use the word research, what comes to your mind? Is it data collection through some qualitative or quantitative method by laboratory work, interviews, questionnaires, etc.? Although data collection is an important part of research, but it is only one step of the wider process comprising of steps before and after the data collection.

What makes a good research? My first preference will go with "ethics". Any research must be ethically sound, and any research conducted through unethical means and methods can never be classified as good research, however path-breaking it might be. Other characteristics of a good research are given in **Box 1**.

The type of research can be qualitative or quantitative (based on approach) and basic or applied research (based on the purpose). While the quantitative or hard research deals with measurements in numerical form to test the hypothesis, the qualitative or soft research is description in narrative form to generate the hypothesis. Similarly, the basic research is concerned with generation of new knowledge and to generate and expand theories, the applied research focuses on finding an immediate solution to an existing

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BOX 1

Characteristics of a good research

- Begin with clearly defined purpose
- Based on current professional issues
- Empirical, reproducible, employs hypothesis
- Generalizability of the results
- Analytical—if data do not support hypothesis, it is hypothesis which is discarded and not the data
- Objective and logical process
- Use of appropriate methodology
- Use of valid and reliable data collection tools
- Carefully recorded and reported
- Adequately communicated

TABLE 1: Prominent features of different types of research

Quantitative research	*Qualitative research*	*Basic research*	*Applied research*
• Deductive approach • Sample size well defined • Researcher remains objectively separated from subject matter • Employment of well-defined statistical methods	• Inductive approach • Sample collection till saturation • Researcher subjectively immersed in the subject matter • No well-defined statistical methods, analyzed by generating themes	• Performed without any specific purpose in mind • There might not be any immediate use	• Have functional purpose in mind while initiating research • Have practical use or application

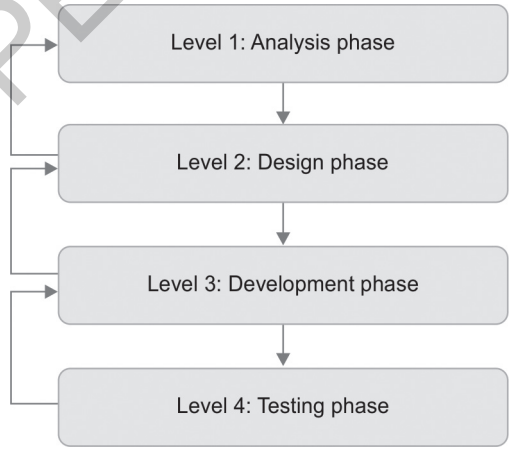
problem/test existing theory. The prominent differentiating features of qualitative versus quantitative research and basic versus applied research are depicted in **Table 1**.

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HOLOGRAM

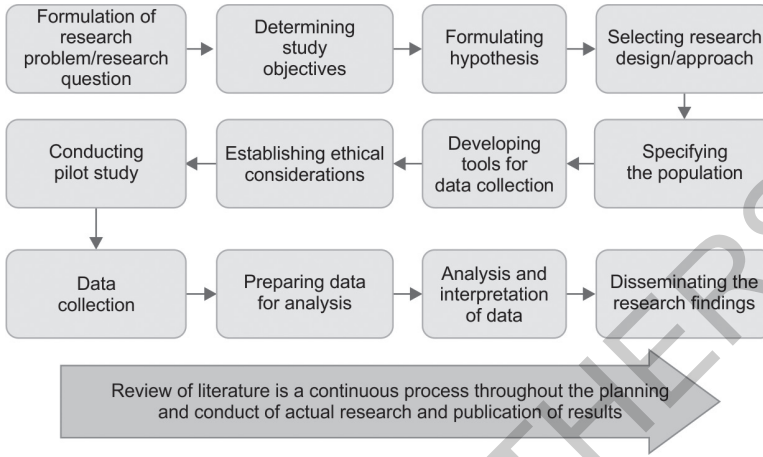
All research accomplishments share the common goal of understanding the research problem more deeply; therefore pass through some basic steps called research steps forming it a cyclic process; the research process. The research process goes through four phases: (1) Analysis phase—deliberation about the problem; (2) Design phase—phase of structuring; (3) Development phase—developing the study protocols; and (4) Testing phase—testing the hypothesis (**Flowchart 1**).

The sequencing and implementation of research steps is dependent upon each other, e.g., you cannot formulate the hypothesis until study objectives are defined or you cannot analyze the data until it is collected. The research process is iterative in nature; you can review the steps of research repeatedly for refinements and improvements time to time to make it a good research study. Moreover, if you carry research in sequential manner, it ensures reproducibility and decides about the best possible alternative for each step in terms of feasibility, acceptability, availability of resources and time. The steps involved while carrying out a research activity have been sequentially represented in **Flowchart 2**.



FLOWCHART 1: Phases of research process

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FLOWCHART 2: Sequential representation of steps in research

You must be wondering that you all must follow each step, every time. It is worth mentioning that each segment is not a discrete step, but part of the whole process. In actual practice, you may not follow the process in such a "neat manner", step by step as shown; you may follow two steps concurrently or may implement the former step later. For example, in quantitative research, data analysis is usually carried out after completing the process of data collection; while in qualitative, data collection and analysis go side by side unless saturation is reached. So, the whole process of steps of research is flexible depending upon the type of research, although whatever model of research you may follow, the basic steps or stages remain same (Kapoor, 2018).

The research process very well can be compared to a journey and for this research journey, you need to take care of two landmarks—what is the research question for which you need answer and how you are looking for your answer (UGCNETPAPER1 TEAM, 2020). To keep you on the track of research journey, the vital "Golden thread"—the research goal and objectives will pave your way. The significance of steps of research is given in **Box 2**.

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BOX 2

Significance of steps of research

- Road map in the process of carrying research
- Reference point to ensure completion of research objectives
- Sequential arrangement makes a logical statement
- Helps in refinement and improvement of each step by revisiting and re-reviewing
- Helps in revising each step as per feasibility and availability of resources
- Make the designed study replicable
- Convince the stakeholders about feasibility of study
- Contribute to the existing scientific knowledge

EXPANSION

Steps of Research

Formulation of Research Problem/Research Question

Research problem is the foundation stone on which your entire study is based, so for good research, the foundation should be strong. Research is driven by problem whose answer is not known by the society; therefore, identification of research problem is important to you for recognition of need of the study. Research problem is defined as "*a general educational issue, concern, or controversy addressed in research that narrows the topic*" (Creswell, 2012).

The first dilemma you will face now—how to identify the research problem? It can be identified by gap in knowledge-need to be filled, deficiency/difficulty requiring urgent consideration, some improvement areas seeking attention, deeper understanding of established theory or confirmation of views in local conditions (Parlindungan, 2018).

The sources which can help you to look for a research problem are—personal or practical experience, critical appraisal of literature, previous research, existing theories, social issues, brainstorming, gut-feeling, and exposure to field situations or consultation with the experts.

Further, research question is the query which you proceed in order to answer the research problem. Research problem is wider,

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while research questions answer the research problem specifically. Research question is "*narrowing the purpose into specific queries that the researcher would like to be answered or addressed in the study*" (Pardede, 2018).

While designing your research, you can employ FINER criteria (**F**easible, **I**nteresting, **N**ovel, **E**thical, and **R**elevant) (Hulley, 2007), and/or PICO/PICOT/PCICOST format (**P**opulation, **I**ntervention, **C**ontrol, **O**utcome/All these plus **T**ime/**P**opulation, **C**ondition, **I**ntervention, **C**ontrol, **O**utcome, **S**etting, and **T**ime) (Haynes, 2006) to develop the research question for clearly building the framework, study protocol, population, time frame, and the intervention. Details of the same have been discussed in Chapter 4 of this book. Do keep in mind that clearly defined population and rigorous inclusion and exclusion criteria help to increase the applicability of research findings on general population.

Determining Study Objectives

Study objectives means summary of what is to be achieved by the study, at specific points. The study objectives always start with an actionable verb. They are in alignment with hypothesis of study and direct to achieve the aim. They are active statements which tell how you are going to answer the research question. The study objectives help in design of study, protocol development, calculation of sample size and power (Hanson, 2006). The objectives which directly answer the research question are primary objectives, rest are secondary. The Good Research objectives must be "SMART", and they should have the "PICO" elements. Being "SMART" means, **S**pecific-clear, well defined, **M**easurable—outcomes should be measurable, **A**chievable—in terms of resources, knowledge, and expertise, **R**ealistic, and **T**ime-bound with a deadline. The good study objectives should also be relevant, feasible, logical, observable, and unequivocal. Research objectives have been discussed in detail in Chapter 5 of this book.

Review of Literature

It is a comprehensive and detailed review for the previous knowledge of a specified research area. The literature review is a journey to explore and review scholarly books, articles, and other resource materials relevant to the topic of interest—to analyze, summarize,

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BOX 3

Relevance of review of literature

- Summarization of relevant information
- Identification of knowledge gaps
- Generation of awareness for already done work
- Avoidance of repetition of previous work
- Justification of proposed research proposal
- Helpful in defining the study objectives
- Resource for research methodology
- For publication of results

describe, and assimilate the available knowledge, to identify the knowledge gaps for a specific subject area and to report/publish the results of the thesis research (**Box 3**). Review of literature is a continuous phenomenon and is carried-out throughout the planning to actual conduct to analysis to publication of results of the thesis research.

You can search the literature through online and offline resources; the online sources include (list is not exhaustive)—PubMed, e-journals, WebMD, Embase, nlm.nih.gov, emedicine.medscape.com, and many more, while the offline can be books, printed journals or news report of particular research. The most common approach to search literature in medical sciences is through PubMed. Details are given in Chapter 6 of this book.

Formulating Hypothesis

The statement or proposition which is to be tested by proposed research is called hypothesis. It is formulated to deduce the relationship between two or more variables—the independent variable (experimental, predictor) and dependent (outcome) variable. The hypothesis provides a tentative answer or explanation to the research question to be tested and states the predictions which the research may find or suggests the outcomes of the study. The research hypothesis clarifies the research problem/objectives, forms the basis for appropriate research design, and facilitates the progress of research.

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Please do not conclude that hypothesis is based merely upon some assumptions. A hypothesis is always based on the previous knowledge, literature review, and conceptual theories and is testable; it can be accepted or refuted through scientific research study.

Therefore, the hypothesis should clearly define the population to be tested, should be focused, relevant, declarative, and verifiable. Depending upon the significance of statistical analysis of results, there can be null hypothesis (H_0) or alternative hypothesis (H_A). The null hypothesis gives the assumption that there is no association; while alternative hypothesis states that there is an association between the predictor and outcome variables. The acceptance of research hypothesis by study outcomes indicates that tentative proposition was right, but rejection does not mean that study was invalid. So, if your data do not support hypothesis, it is hypothesis which is discarded and not your data; the data adds to the already exciting pool of knowledge and gives some conclusion. For any research, you can have several simple hypotheses than the one complex; however, it is always advised to keep it to maximum of six, so as to keep the participants interested in the study and writing the discussion smoothly (Vinayagam, 2019). We will discuss the details in Chapter 4.

Selecting Research Design/Approach

They form the basis for plans and procedures of the research study. A research design is "*an arrangement of the essential condition and analysis of data in a form that aims to combine relevance to research purpose with economy in the procedure"* (Saleem et al., 2014). The research design helps you in deciding about "when", "how much", "what", and "by what" and can depend upon the topic of study, type of data needed, setting and timeline of research, the participating population, the hypothesis of the study, and the variables selected.

The research design may also vary as per the methods of data collection and analysis, procedures of carrying the study and on your personal experiences. The inclusion and exclusion criteria of study, criteria for interpretation of the results and drawing the conclusion will also depend upon research design. There is no single best research design for any study; the selection will depend upon your priorities of the study, however, keep in mind that suitable research design is the key to successful scientific papers and publications.

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Research designs have been discussed in detail in Chapter 3 of this book.

Specifying the Population

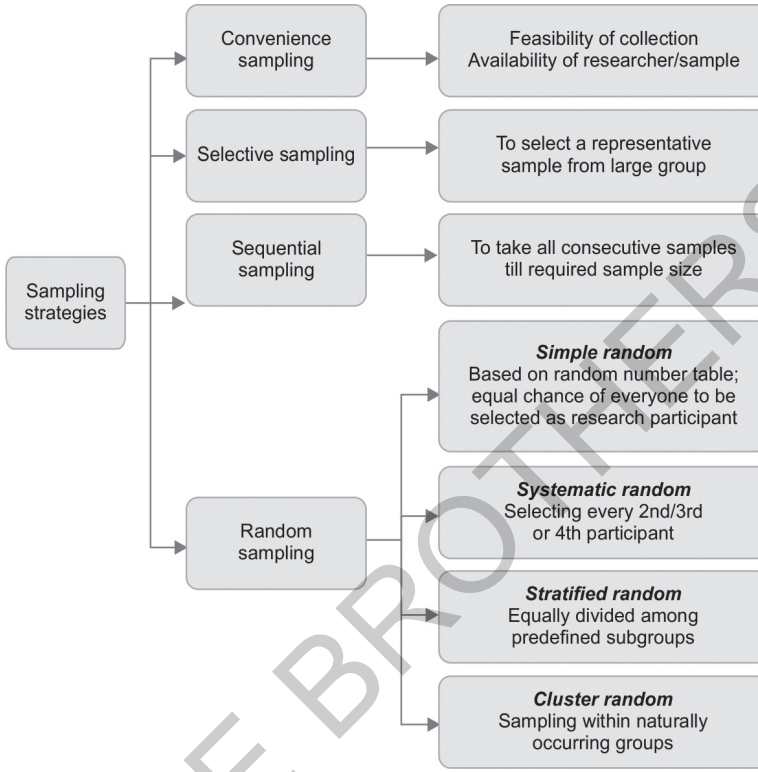
It is the target population or the population of interest in which you are keen to carry the research. The population can be humans, animals, blood samples, culture plates or research studies, which meet certain criteria defined for the subject of your research study. The population can be finite (which can be counted easily, e.g., 2nd phase students of a specific medical institute) or infinite (which can be counted, but in a complex process, e.g., all adolescents of a city). The measurable characteristic of any population is known as parameter.

As it is not always possible to recruit all the individuals/whole population of the study of interest, one can recruit representative group of individuals from same population with a specific characteristic of entire population to assess the information and to carry the study. The research findings from this miniature group called sample can be generalized to the entire population of interest. Further to carry the study in a specific population, it is also important for you to determine the eligibility criteria by which an individual is qualified to participate. The inclusion criteria or any specific criteria based on which the participants are included in the study can be any specific parameter, e.g., age, sex, diagnostic criteria of a disease. On the other hand, the exclusion criteria are not just opposite of inclusion; it indicates some characteristic of population which may interfere with collection of data (Majid, 2018). You may develop eligibility criteria by searching literature and revisiting the PICOT elements of your research objectives.

To obtain the representative sample from the population, you may choose one sampling strategy depending upon the feasibility and tractability of population. The brief account of various sampling strategies is given in **Flowchart 3**.

Further choice about sample size and comparison group is also important step in specifying the population. Try to keep the sample size in such a number so that the conclusion and significance drawn from the study should be applicable to entire population. The comparison group (if it is observational and interventional study) also needs to be decided beforehand on the basis of

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FLOWCHART 3: Commonly employed sampling strategies

specific criteria for considering the subject as control or receiving alternative intervention. Details of population and sample have been discussed in Chapter 9 of this book.

Developing Tools for Data Collection

The tool for data collection can be a piece of equipment or a scale consisting of various types of questions. Data collection tools are term for methodologies which are employed to collect data from specified and specific group of population on certain predefined criteria. The nature of tool will depend upon your study problem, study design, population to be studied, and availability of resources. The selection of data collection tools should be aligned with research hypothesis and information gathered from literature about the included variables.

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Usually the process of data collection starts after the decision of research problem/research design. The selection of data collection tools will differ for the primary data or secondary data. Primary data is original and is collected for the first time by the researcher, while secondary data has been already collected and analyzed through statistical methods. The data collection tools for primary data can be some experimental research, surveys, interviews, observations, questionnaires, etc, while for the secondary data; it can be newspapers, published research articles, books, biographies of persons, records, censuses, and various databases.

Your data collection tools can also vary for the different research designs. The quantitative data collection methods based on structured instruments are mainly for testing the hypothesis and assigning of subjects to different interventional or noninterventional groups. They may include experimental or clinical trials, surveys containing questionnaires with closed-ended questions or interviews (structured) or observation of an event and its recording. The qualitative data collection methods may include reflections, narratives, document reviews, in-depth interviews (usually semistructured and unstructured), focus group discussion or open-ended questions of a questionnaire.

Establishing Ethical Considerations

While conducting research, it is mandatory for you to be familiar with Good Clinical Practice (GCP) defined by International Conference on Harmonisation of Technical Requirement for Registration of Pharmaceuticals for Human Use (ICH 2016) and GCP of Central Drugs Standard Control Organization of India (CDSCO GCP Guidelines, 2014). The ethical issues related to recruitment of human participants, which are primary source of data for study; need to be taken care of to ensure the validation of research ethically and legally.

Four Golden Principles of ethics as elucidated by Belmont Report (hhs.gov., 2016) are Respect for Autonomy (respecting the decision of participant to take part in study/withdraw the participation at any point of time), Beneficence (to do good, protecting the mental, social, and physical well-being of participant), Nonmaleficence (first, do not harm, maximizing the benefit/possible harm ratio), and Justice (fair distribution of risks, benefits). Moreover, before the

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THESIS WRITING
The T, H, E, S, I, S Approach

The book covers a wide range of topics, starting from the importance of thesis writing in postgraduate training and culminating into the scope and space for translational research during postgraduate training. The book has been conceptualized to address the concerns of postgraduate students and doctoral fellows while designing their thesis research, writing protocol of the thesis, followed by the thesis in-proper, and then converting the same into a scholarship activity through poster presentation or paper writing. All the steps of thesis research, required for postgraduate and doctoral research, have been comprehensively discussed. The salient features of the book are as follows:

- Every chapter drafted based upon T, H, E, S, I, S approach, i.e., Tickling, Hologram Expansion, Scenarios, Improvisation, and Summary
- Adequate scenarios included in all chapters
- All thesis-related sample appendices and certificates included
- Concept of timeline and Gantt chart explained in detail
- Introduction to use of Statistical Package for the Social Sciences (SPSS) in statistical analysis
- A newer approach to thesis writing—manuscript-based thesis—discussed in detail

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