

**Module-1 Research Methodology and Literature Survey (5 hours)**

**Research Methodology:** Meaning, Objectives, Types of research, Method versus methodology, Research process, Criteria of good research.

**Literature Survey, Literature Review:** Introduction, process, databases and management tools. Identifying gap areas from literature review. Plagiarism: Introduction, tools for detection, avoiding plagiarism. Illustrations.

## **1.1 Research Methodology**

### **1.1.1 Meaning of Research**

Research in common parlance refers to a search for knowledge. One can also define research as a scientific and systematic search for pertinent information on a specific topic. In fact, research is an art of scientific investigation. The Advanced Learner's Dictionary of Current English lays down the meaning of research as “**a careful investigation or inquiry specially through search for new facts in any branch of knowledge**”. Redman and Mory define research as a “**systematized effort to gain new knowledge**”. Some people consider research as a movement, a movement from the known to the unknown. It is actually a voyage of discovery. We all possess the vital instinct of inquisitiveness for, when the unknown confronts us, we wonder, and our inquisitiveness makes us probe and attain full and fuller understanding of the unknown. This inquisitiveness is the mother of all knowledge and the method, which man employs for obtaining the knowledge of whatever the unknown, can be termed as

**Research is, thus, an original contribution to the existing stock of knowledge making for its advancement.** It is the pursuit of truth with the help of study, observation, comparison and experiment. In short, the search for knowledge through objective and systematic method of finding solution to a problem is research. The systematic approach concerning generalisation and the formulation of a theory is also research. As such the term ‘research’ refers to the systematic method consisting of enunciating the problem, formulating a hypothesis, collecting the facts or data, analysing the facts and reaching certain conclusions either in the form of solutions(s) towards the concerned problem or in certain generalisations for some theoretical formulation.

### **1.1.2 Objectives of Research**

The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Though each research study has its own specific purpose, we may think of research objectives as falling into a number of following broad groupings:

1. To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed as exploratory or formulative research studies);
2. To portray accurately the characteristics of a particular individual, situation or a group (studies with this object in view are known as descriptive research studies);
3. To determine the frequency with which something occurs or with which it is associated with something else (studies with this object in view are known as diagnostic research studies);
4. To test a hypothesis of a causal relationship between variables (such studies are known as hypothesis-testing research studies).

### **1.1.3 Types of Research**

The basic types of research are as follows:

**(i) Descriptive vs. Analytical:** *Descriptive research* includes surveys and fact-finding enquiries of different kinds. The major purpose of descriptive research is description of the state of affairs as it exists at present. In descriptive research, the researcher seeks to measure such items as, for example, frequency of shopping, preferences of people, or similar data. It also includes attempts by researchers to discover

causes even when they cannot control the variables. The methods of research utilized in descriptive research are survey methods of all kinds, including comparative and correlational methods. In analytical research, on the other hand, the researcher has to use facts or information already available and analyse these to make a critical evaluation of the material.

**(ii). Applied vs. Fundamental:** Research can either be applied (or action) research or fundamental (to basic or pure) research. *Applied research* aims at finding a solution for an immediate problem facing a society or an industrial/business organisation, whereas *fundamental research* is mainly concerned with generalisations and with the formulation of a theory. “Gathering knowledge for knowledge’s sake is termed ‘pure’ or ‘basic’ research”. Research concerning some natural phenomenon or relating to pure mathematics are examples of fundamental research. Similarly, research studies, concerning human behaviour carried on with a view to make generalisations about human behaviour, are also examples of fundamental research, but research aimed at certain conclusions (say, a solution) facing a concrete social or business problem is an example of applied research. Thus, the central aim of applied research is to discover a solution for some pressing practical problem, whereas basic research is directed towards finding information that has a broad base of applications and thus, adds to the already existing organized body of scientific knowledge.

**(iii) Quantitative vs. Qualitative:** *Quantitative research* is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity. *Qualitative research*, on the other hand, is concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind. For instance, when we are interested in investigating the reasons for human behaviour (i.e., why people think or do certain things), we quite often talk of ‘Motivation Research’, an important type of qualitative research.

**(iv). Conceptual vs. Empirical:** *Conceptual research* is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones. On the other hand, *empirical research* relies on experience or observation alone, often without due regard for system and theory. It is data-based research, coming up with conclusions which are capable of being verified by observation or experiment. We can also call it as experimental type of research.

**(v) Some Other Types of Research:** All other types of research are variations of one or more of the above stated approaches, based on either the purpose of research, or the time required to accomplish research, on the environment in which research is done, or on the basis of some other similar factor. From the point of view of time, we can think of research either as *one-time research* or *longitudinal research*. In the former case the research is confined to a single time-period, whereas in the latter case the research is carried on over several time-periods. Research can be *field-setting research* or *laboratory research* or *simulation research*, depending upon the environment in which it is to be carried out. Research can as well be understood as *clinical* or *diagnostic research*. Such research follows case-study methods or in-depth approaches to reach the basic causal relations.. The research may be *exploratory* or it may be formalized. The objective of exploratory research is the development of hypotheses rather than their testing, whereas formalized research studies are those with substantial structure and with specific hypotheses to be tested. *Historical research* is that which utilizes historical sources like documents, remains, etc. to study events or ideas of the past, including the philosophy of persons and groups at any remote point of time. Research can also be classified as *conclusion-oriented* and *decision-oriented*. While doing conclusion-oriented research, a researcher is free to pick up a problem, redesign the enquiry as he proceeds and is prepared to conceptualize as he wishes. *Decision-oriented research* is always for the need of a decision maker and the researcher in this case is not free to embark upon research according to his own inclination. Operations research is an example of decision-oriented

research since it is a scientific method of providing executive departments with a quantitative basis for decisions regarding operations under their control.

### **1.1.3 Research Methods versus Research Methodology**

*Research methods* may be understood as all those methods/techniques that are used for conduction of research. *Research methods or techniques, thus, refer to the methods the researchers use in performing research operations.* In other words, all those methods which are used by the researcher during the course of studying his research problem are termed as research methods.

Since the object of research, particularly the applied research, is to arrive at a solution for a given problem, the available data and the unknown aspects of the problem have to be related to each other to make a solution possible. Keeping this in view, research methods can be put into the following three groups:

1. In the first group we include those methods which are concerned with the collection of data. These methods will be used where the data already available are not sufficient to arrive at the required solution;
2. The second group consists of those statistical techniques which are used for establishing relationships between the data and the unknowns;
3. The third group consists of those methods which are used to evaluate the accuracy of the results obtained.

Research methods falling in the above stated last two groups are generally taken as the analytical tools of research.

*Research methodology* is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. In it we study the various steps that are generally adopted by a researcher in studying his research problem along with the logic behind them. It is necessary for the researcher to know not only the research methods but also the methodology.

Research methodology has many dimensions and research methods do constitute a part of the research methodology. The scope of research methodology is wider than that of research methods. *Thus, when we talk of research methodology we not only talk of the research methods but also consider the logic behind the methods we use in the context of our research study and explain why we are using a particular method or technique and why we are not using others so that research results are capable of being evaluated either by the researcher himself or by others.* Why a research study has been undertaken, how the research problem has been defined, in what way and why the hypothesis has been formulated, what data have been collected and what particular method has been adopted, why particular technique of analysing data has been used and a host of similar other questions are usually answered when we talk of research methodology concerning a research problem or study.

### **1.1.4 Research Process**

Research process consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps. The chart shown in Figure 1.1 well illustrates a research process.

The following order concerning various steps provides a useful procedural guideline regarding the research process: (1) formulating the research problem; (2) extensive literature survey; (3) developing the hypothesis; (4) preparing the research design; (5) determining sample design; (6) collecting the data; (7) execution of the project; (8) analysis of data; (9) hypothesis testing; (10) generalisations and interpretation, and (11) preparation of the report or presentation of the results, i.e., formal write-up of conclusions reached.

A brief description of the above stated steps will be helpful.

**1. Formulating the research problem:** There are two types of research problems, viz., those which relate to states of nature and those which relate to relationships between variables. At the very outset the researcher must single out the problem he wants to study. The formulation of a general topic into a specific research problem, constitutes the first step in a scientific enquiry. Essentially two steps are involved in formulating the research problem, viz., understanding the problem thoroughly, and rephrasing the same into meaningful terms from an analytical point of view.

**2. Extensive literature survey:** Once the problem is formulated, a brief summary of it should be written down. At this juncture the researcher should undertake extensive literature survey connected with the problem. For this purpose, the abstracting and indexing journals and published or unpublished bibliographies are the first place to go to. Academic journals, conference proceedings, government reports, books etc., must be tapped depending on the nature of the problem. In this process, it should be remembered that one source will lead to another. The earlier studies, if any, which are similar to the study in hand should be carefully studied. A good library will be a great help to the researcher at this stage.

**3. Development of working hypotheses:** After extensive literature survey, researcher should state in clear terms the working hypothesis or hypotheses. Working hypothesis is tentative assumption made in order to draw out and test its logical or empirical consequences. As such the manner in which research hypotheses are developed is particularly important since they provide the focal point for research. They also affect the manner in which tests must be conducted in the analysis of data and indirectly the quality of data which is required for the analysis.

**4. Preparing the research design:** The research problem having been formulated in clear cut terms, the researcher will be required to prepare a research design, i.e., he will have to state the conceptual structure within which research would be conducted. The preparation of such a design facilitates research to be as efficient as possible yielding maximal information. In other words, the function of research design is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money.

The preparation of the research design, appropriate for a particular research problem, involves usually the consideration of the following:

- (i) the means of obtaining the information;
- (ii) the availability and skills of the researcher and his staff (if any);
- (iii) explanation of the way in which selected means of obtaining information will be organised and the reasoning leading to the selection;
- (iv) the time available for research; and
- (v) the cost factor relating to research, i.e., the finance available for the purpose.

**5. Determining sample design:** The researcher must decide the way of selecting a sample or what is popularly known as the sample design. In other words, a sample design is a definite plan determined before any data are actually collected for obtaining a sample from a given population. Thus, the plan to select 12 of a city's 200 drugstores in a certain way constitutes a sample design. Samples can be either probability samples or non-probability samples.

**6. Collecting the data:** In dealing with any real-life problem it is often found that data at hand are inadequate, and hence, it becomes necessary to collect data that are appropriate. There are several ways of collecting the appropriate data which differ considerably in context of money costs, time and other resources at the disposal of the researcher.

Primary data can be collected either through experiment or through survey. If the researcher conducts an experiment, he observes some quantitative measurements, or the data, with the help of which he examines the truth contained in his hypothesis. But in the case of a survey, data can be collected by observations, through personal interviews, telephonic interviews, by mailing questionnaires etc.

**7. Execution of the project:** Execution of the project is a very important step in the research process. If the execution of the project proceeds on correct lines, the data to be collected would be adequate and dependable. The researcher should see that the project is executed in a systematic manner and in time. If the survey is to be conducted by means of structured questionnaires, data can be readily machine-processed. In such a situation, questions as well as the possible answers may be coded. If the data are to be collected through interviewers, arrangements should be made for proper selection and training of the interviewers.

**8. Analysis of data:** After the data have been collected, the researcher turns to the task of analysing them. The analysis of data requires a number of closely related operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences

Tabulation is a part of the technical procedure wherein the classified data are put in the form of tables. The mechanical devices can be made use of at this juncture. A great deal of data, especially in large inquiries, is tabulated by computers. Computers not only save time but also make it possible to study large number of variables affecting a problem simultaneously.

Analysis work after tabulation is generally based on the computation of various percentages, coefficients, etc., by applying various well-defined statistical formulae. In the process of analysis, relationships or differences supporting or conflicting with original or new hypotheses should be subjected to tests of significance to determine with what validity data can be said to indicate any conclusion(s).

**9. Hypothesis-testing:** After analysing the data as stated above, the researcher is in a position to test the hypotheses, if any, he had formulated earlier. Do the facts support the hypotheses or they happen to be contrary? This is the usual question which should be answered while testing hypotheses.

Various tests, such as Chi square test, t-test, F-test, have been developed by statisticians for the purpose. The hypotheses may be tested through the use of one or more of such tests, depending upon the nature and object of research inquiry. Hypothesis-testing will result in either accepting the hypothesis or in rejecting it. If the researcher had no hypotheses to start with, generalisations established on the basis of data may be stated as hypotheses to be tested by subsequent researches in times to come.

**10. Generalisations and interpretation:** If a hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalisation, i.e., to build a theory. As a matter of fact, the real value of research lies in its ability to arrive at certain generalisations. If the researcher had no hypothesis to start with, he might seek to explain his findings on the basis of some theory. It is known as interpretation. The process of interpretation may quite often trigger off new questions which in turn may lead to further researches.

**11. Preparation of the report or the thesis:** Finally, the researcher has to prepare the report of what has been done by him. Writing of report must be done with great care keeping in view the following:

1. The layout of the report should be as follows: (i) the preliminary pages; (ii) the main text, and (iii) the end matter.

RESEARCH PROCESS IN FLOW CHART

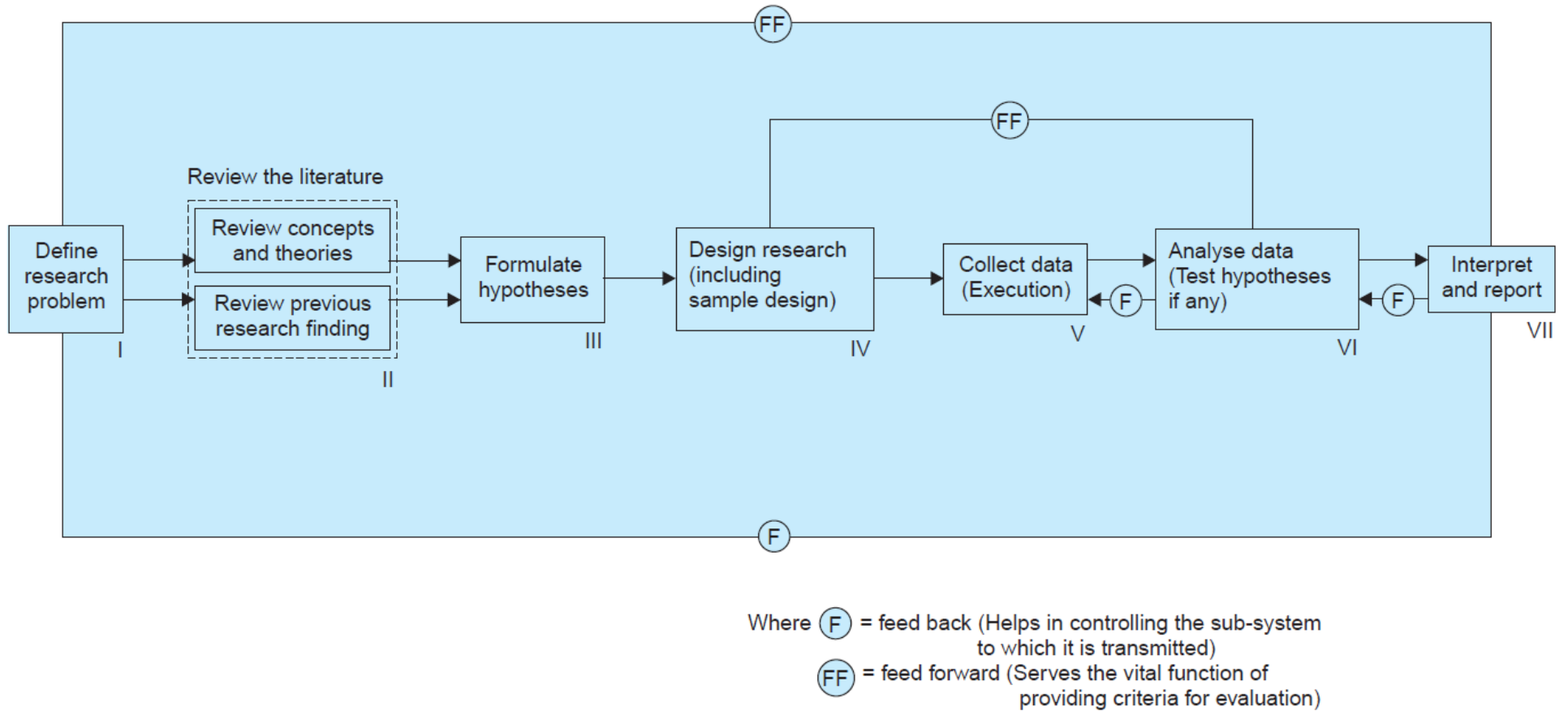


Fig. 1.1 Research Process

### **1.1.5 Criteria of Good Research**

Whatever may be the types of research works and studies, one thing that is important is that they all meet on the common ground of scientific method employed by them. One expects scientific research to satisfy the following criteria.

1. The purpose of the research should be clearly defined and common concepts be used.
2. The research procedure used should be described in sufficient detail to permit another researcher to repeat the research for further advancement, keeping the continuity of what has already been attained.
3. The procedural design of the research should be carefully planned to yield results that are as objective as possible.
4. The researcher should report with complete frankness, flaws in procedural design and estimate their effects upon the findings.
5. The analysis of data should be sufficiently adequate to reveal its significance and the methods of analysis used should be appropriate. The validity and reliability of the data should be checked carefully.
6. Conclusions should be confined to those justified by the data of the research and limited to those for which the data provide an adequate basis.
7. Greater confidence in research is warranted if the researcher is experienced, has a good reputation in research and is a person of integrity.

## **1.2 Literature Review (LR)**

### **1.2.1 Introduction**

Literature Review (LR) can be defined in many ways.

“Systematic and organized compilation and critical study of related body of knowledge is literature survey”

“A literature review surveys books, scholarly articles, and any other source, relevant to a particular issue, area of research, or theory, and by so doing Provides a description, summary, and critical evaluation of these works in relation to the research problem being investigated.”

### **Types of Sources**

- **Primary sources:** The original thesis or data collected and presented by a researcher. E.g.: research papers in journals, patents, Ph D thesis etc.
- **Secondary sources:** The original data and studies of an original stud quoted or collected by another author e.g. review papers.
- **Tertiary sources:** The primary and secondary data collected and presented by different scientists/authors e.g. edited books, news, blogs, and other web resources.

Each and every source has its own merits and demerits. Choose the source wisely. The selection of a type of source depend upon the subject, scope and level of the study.

### **Key Features of Literature Review**

- **Size (depending on the subject/ level of research):** Size means what should be the length and breadth of the content to be collected. It depends on the subject, type of research, scope of research and level of research.
- **Quality:** Search/ refer the quality articles from quality sources/ journals/ publishers/ books. Wrong methods can not lead to right research. Substandard articles, if you will refer, you can not expect a good research. Refer the good quality source. It is utmost important. Quality articles only can lead to reproducible results.

- **Versatility:** Versatility means including all the types of resources not just one, Your LR must contain a good mix of review, research, patents, books, hews, meta-analysis, regulatory guidelines, historical articles/ studies, geographical distribution of compiled studies etc.
- **Up-to-date:** Referring to the current literature plays an important role in LS. References must be recent developments in the field.
- **Do not skip the historical or pioneer studies/** articles of the subject/topic Though in one hand we are saying that only current references should be Cited. But we must not avoid the historical or pioneer reference.
- **Completeness:** Complete the LR with respect to the scope of study (topics, subtopics, allied topics etc) with due focus.
- **Be critical:** Include the studies which may not favour your tentative hypothesis also. You must be self-critical. You planned or trying to hypothesize a thing. You are collecting the supporting evidence. But you must not skip the things which are against your hypothesis or any other contradictory/ controversial things. It will be an unbiased ground of LR.
- **Discuss with the supervisor/ mentor/ team members/ collaborators** for any doubt/ help. There must be a good tune in between.

### **1.2.2 Literature Review Process**

**Step 1: Select a topic:** Select a topic you can manage in the time frame you have to complete your project. Establish your research questions and organize your literature into logical categories around the subject/ topic areas of your questions. Your research questions must be specific enough to guide you to the relevant literature.

Make sure you understand the concept of ‘broader’ and ‘narrower’ terms. The narrower your topic, the easier it will be to limit the number of sources you need to read in order to get a good survey of the literature.

**Step 2: Identify the most relevant sources on your topic:** Use a variety of resources - locate books, journals, and documents that contain useful information and ideas on your topic. Internet sites, theses & dissertations, conference papers, ePrints and government or industry reports can also be included.

Do not rely solely on electronic full-text material which is more easily available. Reference sources such as dictionaries can assist in defining terminology, and encyclopedias may provide useful introductions to your topic by experts in the field and will list key references.

**Step 3: Search and refine:** Search number of databases that provide full text access to articles, that allow you to refine your search to ‘peer reviewed’ journals. These are scholarly journals which go through a rigorous process of quality assessment by several researchers or subject specialists in the academic community before they are accepted for publication.

Use the And, Or, Not operators, Wildcards and Logical Brackets when searching in the databases. For instance, you can use And to narrow your search while the operator OR expands your search. Not, on the other hand, helps to exclude irrelevant information from your search results.

**Step 4: Read and Analyse:** Read the literatures and analyse them finding the answers to possible questions such as - Are there gaps in the literature? Where has significant research taken place, and who has done it? Is there consensus or debate on this topic? Which methodological approaches work best? etc.

**Step 5: Write the Literature Review:** You can organize the review in many ways; for example, you can center the review **historically** (how the topic has been dealt with over time); or center it on



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the **theoretical positions** surrounding your topic (those for a position vs. those against, for example); or you can focus on how each of your sources contributes to your understanding of your project.

Your literature review should include:

- an **introduction** which explains how your review is organized.
- a **body** which contains the **headings** and **subheadings** that provide a map to show the various perspectives of your argument. In other words the body contains the evaluation of the materials you want to include on your topic.
- a **summary**.

### **1.2.3 Literature Review Databases**

#### **Scopus**

Scopus is the subscription based one of the largest databases covering various subjects. It covers all types of peer reviewed resources like literature, scholarly article of journals, books, conference proceedings etc.

Scopus is a multidisciplinary database and it covers sciences, technology, medical, biomedical, social sciences, humanities. It is updated daily 60 million records from more than 21500 journals by more than 360 publishers.

#### **Web of Science (WoS)**

- Web of Science was previously known as Web of Knowledge. It is a Multidisciplinary database.
- WoS is a huge subscription-based scientific citation indexing service. It was originally produced by the Institute for Scientific Information (ISI) and now it is maintained by Clarivate Analysis.
- It searches conference papers, patent data, datasets and data studies, books etc.

#### **PubMed**

- PubMed is a free database covering citations and abstracts from the fields of medical, biomedical, health, Sciences (basic and applied — including pharmaceutical sciences), life sciences, behavioural sciences, chemical sciences, and bioengineering.
- This free web resource is maintained by the National Centre for Biotechnology Information (NCBI) in U.S. National Library of Medicine.

#### **Other free databases**

- Google Scholar : Easily and freely available with advanced filters.
- Directory of Open Access Journals: DOAJ ([www.doaj.org](http://www.doaj.org))
- DOAB (Directory of Open Access Books)
- DOAR (Directory of Open Access Repository)

#### **Indian Databases**

##### **Information and Library Network (INFLIBNET) Centre**

Information and Library Network (INFLIBNET) Centre is an autonomous Inter-University Centre of the University Grants Commission (UGC) of India. It helps in modernizing university libraries in India and connecting them with high speed network. It provides quality learning and literature database for students, teachers and researchers.

This centre provides a huge variety of databases.

- Information and Library network centre (founded by UGC)
- SHODHGANGOTRI
- SHODHGANGA
- eSHODHSINDHU
- ICSSR DATA SERVICE
- INDCAT , VIDWAN; EXPERT DATABASE

### **1.2.4 Literature Management Tools**

Some functions that can be performed by literature management tools for research:

1. **Create and store citations to efficiently generate an accurate bibliography:** Integrate with your word processing program to insert citations and change journal format; can use a variety of styles and journal formats
2. **Search the literature:** good reference management tools for research will recommend articles based on your library or written text; external search function
3. **Organize and store PDFs:** use folders and tags to organize the reference library; search for documents by author name, keywords, text, notes; highlight passages and annotate PDF files
4. **Foster collaboration:** allows you to share your library with colleagues
5. **Create mobility:** can sync references across multiple devices.

#### **Three Major Literature Management Tools are:**

1. **EndNote:** The most powerful, and complex, of the commonly used reference management software, EndNote is available in standalone (installed on your computer) and online versions. The desktop version is priced at \$249.50 (\$115.95 for a student license); the online version is free but lacks many features included in the desktop version.
2. **Mendeley:** Mendeley may be the most popular reference management tool in research. It comes in free and premium (paid) versions and allows users to manage their references quickly and effectively.
3. **Zotero:** Zotero is a free, open-sourced reference management tool for research that allows users to collect, save, and cite references in one place.

### **1.2.5 Author Metrics**

Author metrics are quantitative measures used to evaluate the scholarly impact, productivity, and influence of individual researchers within the academic community. These metrics provide insights into an author's publication output, citation impact, and collaboration patterns. Some commonly used author metrics include:

**h-index:** The h-index is a popular author-level metric that combines both productivity and citation impact. An author with an h-index of h has published h papers that have each been cited at least h times.

**i10-index:** This index, introduced by Google Scholar, reflects the number of an author's publications that have received at least ten citations.

**Citation Count:** This metric simply counts the total number of citations an author's work has received. It gives an indication of the overall impact or visibility of the author's research.

**h-index Variants:** There are variants of the h-index, such as the g-index (which considers highly cited papers) and the m-index (which accounts for an author's productivity over time).

**Collaboration Metrics:** Metrics related to collaboration, such as co-authorship networks or the number of co-authored publications, provide insights into an author's collaborative efforts within the scholarly community.

**Altmetrics for Authors:** Similar to journal-level altmetrics, these metrics track the online attention received by an author's work through social media mentions, downloads, saves, and other online activities.

Author metrics are used by researchers, academic institutions, and funding agencies for various purposes, including evaluating researchers for tenure or promotion, assessing grant applications,

identifying potential collaborators, and understanding an individual's contribution to their field. Evaluating an author's impact should involve a comprehensive assessment that considers qualitative aspects of their work alongside quantitative metrics.

### **1.2.6 Journal Metrics**

Journal metrics are quantitative measures used to assess the impact, influence, quality, and reach of academic journals within the scholarly community. These metrics are essential tools for researchers, publishers, and institutions to evaluate the significance and performance of scholarly publications. Some commonly used journal metrics include:

**Impact Factor (IF):** Impact Factor is one of the most well-known metrics. It measures the average number of citations received by articles published in a journal within a specific timeframe, typically calculated annually. The higher the impact factor, the more influential the journal is considered within its field.

**CiteScore:** Similar to the Impact Factor, CiteScore measures the average citations received per document over a specific period, usually a year. It is calculated by Scopus and may provide a broader view compared to Impact Factor, as it considers more document types.

**Eigenfactor Score:** This metric evaluates the overall importance of a journal in its field by considering the number of incoming citations to the journal and the significance of the citing journals.

**Article Influence Score:** Introduced by Eigenfactor, it measures the average influence of a journal's articles over a five-year period, providing a more long-term view of a journal's impact.

**h-index of the journal:** This metric assesses both the productivity and impact of the articles published in a journal. A journal's h-index is determined by the number of articles it has published that have received at least the same number of citations.

**Altmetrics:** These metrics take into account non-traditional indicators such as social media mentions, downloads, and other online activity to measure the reach and influence of research beyond citations.

It's important to note that while journal metrics provide valuable insights, they should be used cautiously and in conjunction with qualitative assessment, as they have limitations and may not fully represent the quality or significance of individual articles within a journal. Moreover, different disciplines and fields may have unique citation patterns, which can influence how these metrics are interpreted.

## **1.3 Identifying gap areas from literature review**

### **1.3.1 Research gap**

When you read papers or books on topics of your interest, you may realize there are some areas that have significant scope for more research but they have not been tapped by other researchers. In other words, no one has picked up or worked on these ideas. A research gap or a literature gap refers to such unexplored or underexplored areas that have scope for further research.

### **1.3.2 Different ways to identify the research gaps**

#### **1. Look for inspiration in published literature**

Read books and articles on the topics that you like the most. This will not only help you understand the depth of work done by researchers in your field but also provide an opportunity to ask questions that can lead you to a research gap.

You can ask yourself questions like:

- What is the significance of this research to my work or the broader field?
- How can this article help me formulate my research questions?

- Does the author's argument require more clarification?
- What issues or questions has the author not addressed?
- Is there a different perspective that I can consider?
- What other factors could have influenced the results?
- Are the methods or procedures used outdated or no longer considered valid in your field?
- Is there scope for you to test the findings using more a current approach?

While reading the research articles, one can find the research gaps in the directions or suggestions for further research given by the article authors. Review papers help you to learn more about the developments and trends in research over the years in the area of your liking. This will help you get acquainted with the problems that have been researched upon in the past as well as trending queries on those topics that you find interesting.

## **2. Seek help from your research advisor**

Discuss the issues and problems in your field with your research advisor to generate ideas for research. Articulating your ideas and knowing what others think and are working on may help you identify your study area or even identify mistakes in your approach. If you think a question would be interesting to work on, you can discuss it with your advisor and get their suggestions.

## **3. Use digital tools to seek out popular topics or most cited research papers**

To familiarize yourself with the trending queries in your field, you can use digital tools as they can save time and help you cast a wider net in your search for a research gap. Websites help to identify the most cited papers in a field along with the emerging branches, influential contributors, publications, and countries in that field can be immensely useful to know which topics are considered important. You can also use Google Trends to learn more about the popular questions related to your research area. This will ease your search for an untapped area in your research field.

## **4. Check the websites of influential journals**

The websites of prominent journals often have a section called 'key concepts' where experts in an area highlight the central ideas in that field. Reading through this section can help you gain a lot of insights and generate new ideas as well. Moreover, you should also look through the reference section of these papers as it can lead you to important resources on the topic.

## **5. Make a note of your queries**

It is a good practice to note all the questions that cross your mind while reading any published literature. If possible, you should map the question to the resource it is based on. You can use tables, charts, pictures, or tools to maintain a record. This can help you in the long run when you are developing your idea into a research problem or even when writing your manuscript.

## **6. Research each question**

Once you have a list of questions that could be explored, you must conduct thorough research on them. What does this mean? Read more about each doubt or query that you have. Find out if other researchers have had similar questions and whether they have found answers to them. This will help you avoid duplication of work.

While you finalize an unprecedented research idea, make sure you consider the time frame available to complete the project as well as other important aspects such as the availability of funds, equipment, and infrastructure.

## **1.4 Ethics in research and publications**

**1.4.1 Introduction:** Research Ethics is defined here to be the ethics of the planning, conduct, and reporting of research. It is clear that research ethics should include: Protections of human and animal subjects.

The application of basic ethical concepts to research activities, such as the design and implementation of research, respect for society and others, the use of resources and research outputs, scientific misconduct, and research regulation, is what research ethics is all about.

**1.4.2 Importance of research ethics :**Both researchers and participants gain from following ethical norms and principles. To begin with, they aid in the promotion of research's broad goals, such as the pursuit of knowledge and the desire to avoid errors. Second, ethics encourage qualities such as respect, trust, and accountability, which are essential for successful collaboration. Third, they play a vital role in holding researchers accountable to societies and communities, which increases public trust and support for research.

For a variety of reasons, research ethics are critical. They foster research goals such as knowledge expansion. They believe in ideals like mutual respect and fairness, which are essential for collaborative work. Because scientific research relies on collaboration between researchers and groups, this is critical.

Ethics are the principles that guide us to make a positive impact through our decisions and actions. Ethics play an important role not only in our personal lives but also in business. We are all encouraged to make ethical choices and apply ethics in all areas of our lives.

### **1.4.3 Principles of research ethics**

Undeniably, researchers face several ethical requirements. Every researcher must meet the set institutional, federal and professional standards for conducting research that involves human participants. The following are some of the general research ethics:

**Honesty** – researchers should honestly report data, research methods, and procedures, results, and publication status. Never falsify, fabricate or misrepresent data.

**Objectivity** – always aim to avoid biases in experimental design, data analysis and interpretation, personal decisions, expert testimony, peer review and all other aspects of research.

**Integrity** – do not act contrary to your promises and agreements. Do your research with sincerity and endeavor for regularity of thought and action.

**Carefulness** – avoid negligence and making careless errors. Ensure that you carefully and critically scrutinize your work as well as the work of your friends. It is always good to keep the records for every research activity.

**Respecting intellectual property** – always respect copyrights, patents and any other type of intellectual property. Never use unreleased data, methods or results without consent. Never plagiarize, and always give credit where it is due.

**Confidentiality** – safeguard confidential information like personal information, military or trade secrets, and patient records. Never disclose any of this information without the necessary permission.

## **1.5 Plagiarism**

### **1.5.1 Introduction**

Plagiarism is academic / literary theft (intentionally or unintentionally). Plagiarism occurs when someone uses other person's language, ideas or any other type of text material, figure and graph which do not belong to common original knowledge without its acknowledgement.

According to the Merriam – Webster online dictionary, to “plagiarize” means:

- “To steal and pass off (the ideas or words of another) as one’s own
- To use (another’s production) without crediting the source
- To commit literary theft
- To present as new and original an idea or product derived from an existing source”

Things to be done –

- You should not take or reproduce any theory, idea or any other study material of another person without acknowledgement.

**1.5.2 Plagiarism Detection Tools:** Plagiarism detection tools are software applications designed to identify instances of plagiarism or unoriginal content in written documents, research papers, essays, articles, and other forms of textual content. These tools employ various techniques to compare the submitted text against a vast database of existing content to find similarities or matches. Here are some commonly used plagiarism detection tools and methods:

**Turnitin:** A widely used tool in educational institutions, Turnitin compares submitted papers against its extensive database and provides a similarity report highlighting areas that match existing sources. It detects similarities in text and provides an originality score.

**Grammarly:** While primarily known as a grammar-checking tool, Grammarly also includes a plagiarism checker feature in its premium version. It scans text against a large database and flags potential instances of plagiarism.

**Copyscape:** Mainly used for web content, Copyscape checks for plagiarism by scanning the internet for duplicate content. It helps website owners and content creators identify unauthorized copies of their content online.

**Plagscan:** This tool compares submitted documents against online sources and proprietary databases to identify similarities and generate detailed reports highlighting potentially plagiarized content.

**Quetext:** Quetext is an online plagiarism detection tool that compares submitted text against a vast database to identify matching content and provides a similarity report.

**MOSS (Measure of Software Similarity):** Primarily used in programming and computer science, MOSS detects similarities in source code. It's often employed in academic settings to identify code plagiarism.

**Manual Google Search:** While not a dedicated tool, using specific search techniques on search engines like Google by enclosing phrases in quotation marks or using advanced search operators (such as "site:") can help manually detect copied content from online sources.

These tools typically use algorithms like fingerprinting, string matching, natural language processing (NLP), and other text comparison techniques to detect similarities between the submitted content and existing texts. They generate reports highlighting matched sections and provide a percentage or score indicating the degree of similarity.

It's important to note that while these tools are helpful in identifying potential instances of plagiarism, human judgment is crucial to interpret the results accurately. Not all matches signify plagiarism; some may be legitimate citations or common phrases. Therefore, manual review and contextual analysis are necessary to determine the nature of detected similarities.

### **1.5.3 Avoiding Plagiarism**

Avoiding plagiarism involves properly crediting and acknowledging sources when using information, ideas, or language from other works. Here are several key practices to help prevent plagiarism:

**Cite Sources:** Whenever you use someone else's ideas, words, or data, cite the source. This includes direct quotes, paraphrases, summaries, and even ideas that are not common knowledge. Use the appropriate citation style (APA, MLA, Chicago, etc.) recommended by your institution or publisher.

**Understand Proper Paraphrasing:** When paraphrasing, rephrase the original text in your own words while retaining the meaning. Ensure that the structure and organization of the information are different from the original.

**Use Quotations:** When directly quoting a source, use quotation marks and provide the correct citation. This indicates that the exact words are from the original source.

**Manage References and Notes:** Keep thorough notes of all sources consulted during research. Record bibliographic information (author, title, publication date, etc.) to properly cite them later.

**Develop Your Own Ideas:** Focus on developing original thoughts and ideas backed by evidence and research. Combine information from various sources to create new insights and interpretations.

**Give Credit for Common Knowledge:** Information that is common knowledge or widely accepted facts (e.g., historical dates, scientific principles) doesn't require citation. However, if in doubt, it's better to cite the source.

**Use Plagiarism Detection Tools:** Before submitting your work, utilize plagiarism detection software or online tools to check for unintentional similarities with existing content.

**Seek Guidance:** If you're unsure about proper citation practices or how to use sources correctly, consult style guides, academic writing centers, or your instructors for guidance.

**Plan Ahead and Manage Time:** Procrastination can lead to rushed writing, increasing the likelihood of accidental plagiarism. Start your assignments early to have enough time for research, writing, and proper citation.

**Review and Edit:** Always review your work before submission. Check citations, references, and quotations to ensure accuracy and completeness.

By following these practices and maintaining academic integrity, one can effectively avoid plagiarism and properly acknowledge the intellectual contributions of others while presenting his/her own original work.

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**A. Short answer type questions**

1. State any two objectives of Research.
2. Distinguish between qualitative and quantitative Research.
3. What do you mean by Research Methods and Research Methodology?
4. What do you understand by Sample Design in the Research Process?
5. List any 4 criteria for good research.
6. Give few examples of Tertiary Sources used in Literature Review.
7. What do you mean by Impact factor of journals?
8. Define h-index as author level metric.
9. List principles of Research ethics.
10. Name any 4 plagiarism detection tools.

**B. Descriptive answer type questions**

1. What do you mean by Research? Explain its importance in Engineering.
2. Explain any 4 basic types of Research.
3. Briefly describe the different steps involved in a research process with a neat flowchart.
4. Discuss the criteria for good Research.
5. List and Explain the steps involved in the literature review process.
6. Discuss the different ways used to identify the research gaps.
7. Explain the importance and principles of Research Ethics.
8. What do you mean by Plagiarism? Explain at least 5 key practices to help prevent plagiarism.

**C. Discussion type questions**

1. Use the research process steps to outline how you would carry out a study on the effectiveness of online learning platforms for engineering students during internships.
2. Demonstrate how you would use reference management tools like Zotero or Mendeley to organize sources during a literature review on electric vehicle adoption in India.
3. Differentiate between basic and applied research using a real-world engineering example from your field of study.
4. Analyze the reasons why researchers may unintentionally commit plagiarism, and propose strategies to mitigate this risk.
5. Evaluate the quality of a given research paper based on the criteria of good research (e.g., clarity, systematic approach, objectivity, etc.).
6. Critically assess two different literature reviews on the same topic and argue which one is more effective and why.
7. Design a research methodology framework for a project aimed at enhancing renewable energy usage in rural areas.
8. Create an infographic or conceptual map that illustrates the differences between "method" and "methodology" with examples from engineering research.

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