Research Methodology

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Questions

- Why Study RM & IPR?

- Who can invent?

- How can RM & IPR help in research?

- How can it contribute to more efficient or effective handling of routine activities ?

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SCHOOL

SCHOOL

Braille Printer Using LEGO (Shubham Banerjee)

Age: 12

Invention: Shubham Banerjee created a low-cost Braille printer using a LEGO Mindstorms EV3 kit. Named Braigo, the printer provides an affordable solution for visually impaired individuals to access printed text in Braille, a major improvement over traditional Braille printers, which are often very expensive.

Impact: Braigo significantly reduced the cost of Braille printing and received widespread attention for its social and economic value

Water Purifier Bike (Chandrakant Singh)

Age: 14

Invention: Chandrakant Singh, a schoolboy from India, designed a bicycle that purifies water as you pedal. The bike is equipped with filters that clean contaminated water, providing an innovative solution for access to clean drinking water in rural areas.

Impact: This invention helps solve water scarcity problems in areas where access to clean water is limited, particularly during travel or in remote locations

Flashlight Powered by Body Heat (Ann Makosinski)

Age: 15

Invention: Ann Makosinski, a Canadian student, invented a flashlight powered by the heat from the human hand. The flashlight uses thermoelectric generators to convert heat into electricity, eliminating the need for batteries.

Impact: This invention is an eco-friendly solution to lighting in emergencies or remote areas, reducing dependency on batteries and electricity

Who Recognises

- National Innovation Foundation (NIF)
- Atal Innovation Mission (AIM)
- Central Board of Secondary Education (CBSE)
- Indian Institute of Technology (IIT) – Tech Fests
- INSPIRE Awards – MANAK
- KVS and Navodaya Vidyalaya Samiti Science Exhibitions

Contents

- Meaning of Research,
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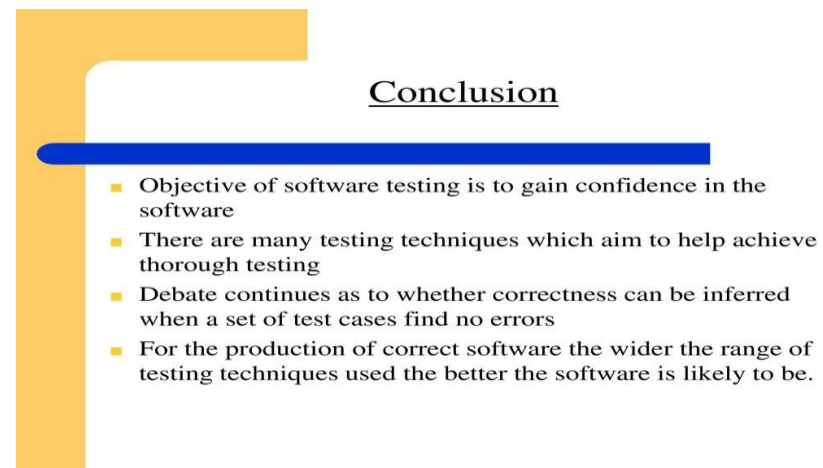
MEANING OF RESEARCH
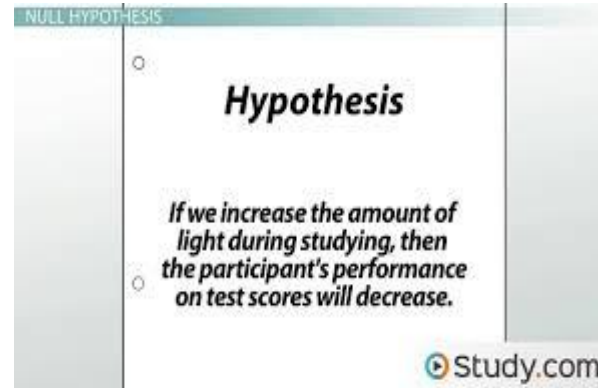
MEANING OF RESEARCH

- Research in common parlance refers to a search for knowledge.

- Once can also define research as a scientific and systematic search for pertinent information on a specific topic.

- A careful investigation or inquiry especially through a search for new facts in any branch of knowledge.

1 Redman and Mory define research as a "systematized effort to gain new knowledge.

2 Some people consider research as a movement, a movement from the known to the unknown. It is actually a voyage of discovery.
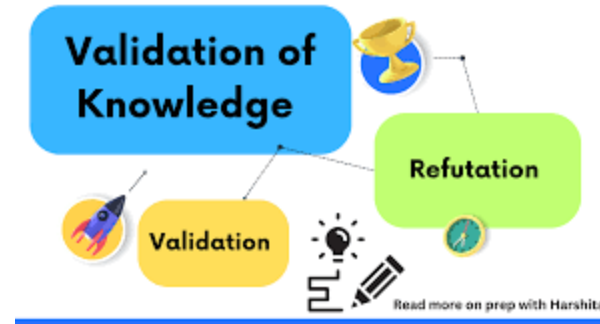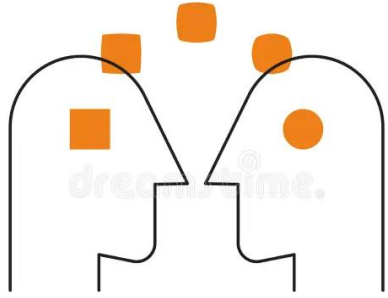
MEANING OF RESEARCH

- Research is an academic activity

MEANING OF RESEARCH

- <u>**Research is an academic activity**</u>

- Clifford Woody research comprises

  - ✓ Defining and redefining problems,

  - ✓ Formulating hypothesis or suggested solutions;

  - ✓ Collecting, organizing and evaluating data;

  - ✓ Making deductions and reaching conclusions;

  - ✓ and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis.

MEANING OF RESEARCH

MEANING OF RESEARCH

- D. Slesinger and M. Stephenson in the Encyclopaedia of Social Sciences define research as

  - ✓ The manipulation of things, concepts, or symbols for the purpose of generalizing to extend,

  - ✓ Correct or verify knowledge,

  - ✓ Whether that knowledge aids in the construction of theory or in the practice of an art."

- 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.

OBJECTIVES OF RESEARCH

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 formative 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)

OBJECTIVES OF RESEARCH

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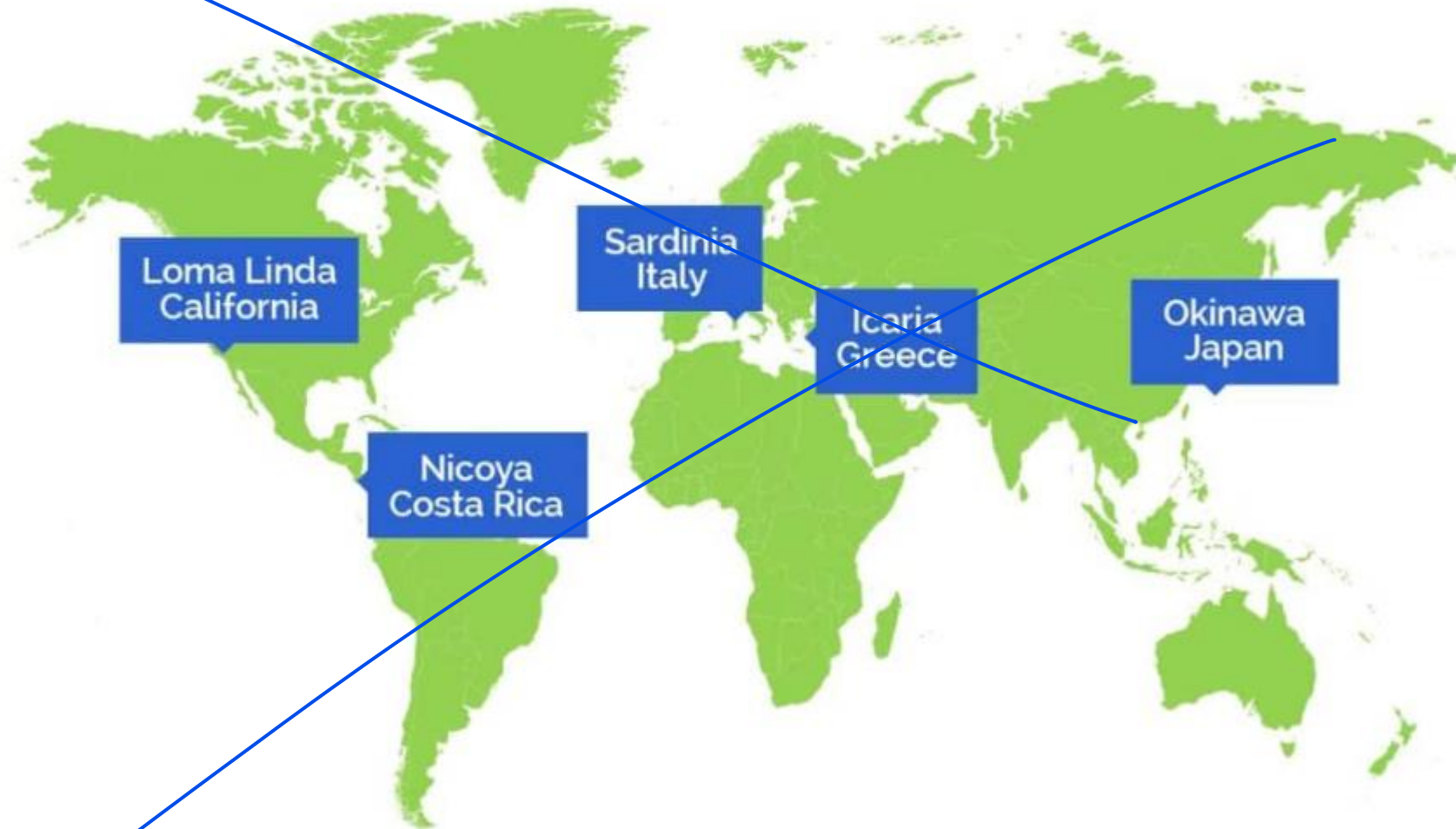
MOTIVATION IN RESEARCH

- The possible motives for doing research may be either one or more of the following:

1. Desire to get a research degree along with its consequential benefits;

2. Desire to face the challenge in solving the unsolved problems, i.e., concern over practical problems initiates research;

3. Desire to get intellectual joy of doing some creative work

4. Desire to be of service to society

5. Desire to get respectability

TYPES OF RESEARCH

- The basic types of research are as follows:

1. Descriptive vs. Analytical

2. Applied vs. Fundamental

3. Quantitative vs. Qualitative

4. Conceptual vs. Empirical

5. Some Other Types of Research

TYPES OF RESEARCH : Descriptive vs. Analytical

TYPES OF RESEARCH : Descriptive vs. Analytical

- Descriptive research includes surveys and fact-finding inquiries of different kinds.

- The major purpose of descriptive research is description of the state of affairs as it exists at present.

- The main characteristic of this method is that the researcher has no control over the variables; he can only report what has happened or what is happening.

- Most ex post facto research projects are used for descriptive studies in which the researcher seeks to measure such items as, for example, frequency of shopping, preferences of people, or similar data.

- Ex post facto studies also include 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 analyze these to make a critical evaluation of the material.

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TYPES OF RESEARCH : Applied vs. Fundamental

TYPES OF RESEARCH : Applied vs. Fundamental

- Applied research aims at finding a solution for an immediate problem facing a society or an industrial/business organization, whereas fundamental research is mainly concerned with generalizations and the formulation of a theory.
    - **Example:** Research concerning some natural phenomenon or relating to pure mathematics are examples of fundamental research.
    - **Example:** research studies, concerning human behaviour carried on with a view to making generalizations about human behavior, 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.
    - **Example:** Research to identify social, economic or political trends that may affect a particular institution or copy research marketing research or evaluation research are examples 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

TYPES OF RESEARCH : Quantitative vs. Qualitative

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TYPES OF RESEARCH : Quantitative vs. Qualitative

- Quantitative research is based on the measurement of quantity or amount.

- 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 behavior (qualitative research)
  - This type of research aims at discovering the underlying motives and desires, using in-depth interviews for the purpose.

- Other techniques of such research are word association tests, sentence completion tests, story completion tests, and similar other projective techniques.

- Attitude or opinion research i.e., research designed to find out how people feel or what they think about a particular subject or institution is also qualitative research.

- Through such research we can analyse the various factors which motivate people to behave in a particular manner or which make people like or dislike a particular thing.

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TYPES OF RESEARCH

Conceptual vs. Empirical

- Conceptual research is that related to some abstract ideas or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret the existing one.

- Empirical research relies on experience or observation, often with some data based research. It is necessary to get all facts and information at first hand.

TYPES OF RESEARCH : 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.

- 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 that are capable of being verified by observation or experiment. We can also call it as experimental type of research.
  - In such research, the researcher must first provide himself with a working hypothesis or guess as to the probable results.
  - He then works to get enough facts (data) to prove or disprove his hypothesis.
  - He then sets up experimental designs
  - Such research is thus characterized by the experimenter's control over the variables

TYPES OF RESEARCH : 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,

  - ✓ the time required to accomplish research,

  - ✓ 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.

- 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 also be understood as clinical or diagnostic research.

  - Such research follows case-study methods. Such studies usually go deep into the causes of things or events that interest us, using very small samples and very deep probing data gathering devices.

TYPES OF RESEARCH : Some Other Types of Research

- 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.

- 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.

TYPES OF RESEARCH : Some Other Types of Research

- 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 in time.

Historical Research

Research Ethics

- Research ethics is a core aspect of the research work and the foundation of research design.

- Research ethics are the set of ethics that govern how scientific and other research is performed at research institutions such as universities, and how it is disseminated.

- When most people think of research ethics, they think about issues that arise when research involves human or animal subjects.

- While these issues are indeed a key part of research ethics, there are also wider issues about standards of conduct.

- These include the importance of publishing findings in a transparent way, not plagiarising others' work, and not falsifying work.

ETHICAL ISSUES IN RESEARCH

1. Study design and ethics approval
2. Data analysis
3. Authorship
4. Conflicts of interest
5. Redundant publication and plagiarism
6. Research Methods
7. Voluntary Participation and Consent
8. Validity
9. Sampling
10. Risk of Harm

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1. Study design and ethics approval

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1. Study design and ethics approval

- Good research should be well adjusted, well-planned, appropriately designed, and ethically approved.

- the basic requirement of a researcher to conduct research responsibly.

- To achieve this, a research protocol should be developed and adhered to.

- It must be carefully agreed to by all contributors and collaborators, and the precise roles of each team member should be spelled out early, including matters of authorship and publications.

- Research should seek to answer specific questions, rather than just collect data.

- The researchers should pay special attention to vulnerable subjects to avoid breach of ethical codes (e.g. children, prisoners, pregnant women, mentally challenged, educationally and economically disadvantaged).

- **Consent** should be explained and obtained from the subjects or guardians, and steps should be taken to ensure confidentiality of information provided by the subjects.

2. Data analysis

2. Data analysis

- It is the responsibility of the researcher to analyse the data appropriately.

- Although inappropriate analysis does not necessarily amount to misconduct, intentional omission of result may cause misinterpretation and mislead the readers.

- Fabrication and falsification of data do constitute misconduct.

- To ensure appropriate data analysis, all sources and methods used to obtain and analyze data should be fully disclosed.

- The **discussion section** of a paper should mention any issues of bias, and explain how they have been dealt with in the design and interpretation of the study.

3. Authorship

- It is generally agreed that an author should have made substantial contribution to the intellectual content, including conceptualizing and designing the study; and acquiring, analyzing and interpreting the data.

- The author should also take responsibility to certify that the manuscript represents valid work and take public responsibility for the work.

- Finally, an author is usually involved in drafting or revising the manuscript, as well as approving the submitted manuscript.
  - Data collection, editing of grammar and language, and other routine works by itself, do not deserve an authorship.

- It is crucial to decide early on in the planning of a research who will be credited as authors, as contributors, and **who will be acknowledged**.

- It is also advisable to read carefully the "Advice to Authors" of the target journal which may serve as a guide to the issue of authorship.

3. Authorship

4. Conflicts of interest

- This happens when researchers have interests that are not fully apparent and that may influence their judgments on what is published.

- These conflicts include personal, commercial, political, academic or financial interests.
    - Financial interests may include *employment, research funding, stock or share ownership, payment for lecture or travel, consultancies and company support for staff*.

- Such interests, where relevant, should be discussed in the early research stage.

- The researchers need to take extra effort to ensure that their conflicts of interest do not influence the methodology and outcome of the research.

- It would be useful to consult an independent researcher, or Ethics Committee, on this issue if in doubt.

- When publishing, these conflicts of interest should be declared to editors, and readers will judge for themselves whether the research findings are trustworthy.

5. Redundant publication and plagiarism

- **Redundant publication** occurs when two or more papers, without full cross reference, share the same hypothesis, data, discussion points, or conclusions.

- However, previous publication of an abstract during the proceedings of meetings does not preclude subsequent submission for publication, but full disclosure should be made at the time of submission.

- This is also known as **self-plagiarism.**

    - In the increasingly competitive environment where appointments, promotions, and grant applications are strongly influenced by publication records, researchers are under intense pressure to publish, and a growing minority is seeking to bump up their CVs through dishonest means.

- On the other hand, **plagiarism** ranges from unreferenced use of others' published and unpublished ideas, including research grant applications to submission under "new" authorship of a complete paper, sometimes in different language.

- Therefore, it is important to disclose all sources of information, and if large amount of other people's written or illustrative materials is to be used, permission must be sought

6. Research Methods

- We know there are numerous research methods.

- However, when it comes to ethical considerations, some key questions can help us find the right approach for our studies.

i. Which methods most effectively fit the aims of your research?

ii. What are the strengths and restrictions of a particular method?

iii. Are there potential risks when using a particular research method?

7. Voluntary Participation and Consent

- An individual should at no point feel any coercion to participate in a study.

- This includes any type of persuasion or deception in attempting to gain an individual's trust.

- Informed consent states that an individual must give their explicit consent to participate in the study.

- You can think of a consent form as an agreement of trust between the researcher and the participants.

8. Validity

- The research design must address specific research questions.

- Hence, the conclusions of the study must correlate to the questions posed and the results.

- Also, research ethics demands that the methods used must relate specifically to the research questions.

9. Sampling

- **Sampling** is the first step in research design.

- You will need to explain why you want a particular group of participants.

- You will have to explain why you left out certain people or groups.

- In addition, if your sample includes children or special needs individuals, you will have additional requirements to address like parental permission.

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10. Risk of Harm

- We should do everything in our power to protect study participants.

- For this, we should focus on the risk-to-benefit ratio.

- If possible risks outweigh the benefits, then we should abandon or redesign the study.

- Risk of harm also requires us to measure the risk to benefit ratio as the study progresses.

Contents

- Types of Research Misconduct
- Literature Review and Technical Reading,

What is research misconduct?

- Research or scientific misconduct refers to actions and behaviors by researchers that fail to honor research integrity.

- The Office of Research Integrity defines research misconduct as the falsification, fabrication or plagiarism in conducting, planning, reporting or reviewing research.

- Simply put, research misconduct is any intentional deviation from ethical research practices.

- **<u>Example</u>** is deliberately creating names and details of survey participants for the purpose of generating data, which is an unethical research practice.

- **<u>Examples</u>** include modifying or omitting data to influence study findings or withholding critical information from human participants in clinical trials or experiments. or scientific misconduct refers to actions and behaviors by researchers that fail to honor research integrity

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Types of Research Misconduct

- Some of the most common types of research misconduct have been detailed below.

1. *Fabrication:* This refers to the practice of making up data without having done the required research. Research misconduct covers not only the act of fabrication, but also the sharing, discussing, or publishing of this fabricated data or results.

2. *Falsification:* This type of scientific misconduct involves the willful manipulation of data, materials, processes, or equipment to arrive at a predefined conclusion. One such example would be selectively omitting or changing data, which results in the erroneous representation of research results.

3. *Plagiarism:* This is one of the most common types of scientific misconduct, and involves using another person's ideas, content, writing, processes, or results without giving due credit. This also includes *self-plagiarism*, which occurs when you replicate your own writings or ideas from previously published research without providing proper credit.

Types of Research Misconduct

4. ***Authorship:*** This type of scientific misconduct in research includes attempts to assign false authorships without adequate contribution to research, mentioning authors without their consent, or failing to include authors who are original contributors. Naming authors in the wrong order or incorrectly is also considered unethical.

5. ***Conflicts of interest:*** These conflicts of interest may be financial, personal, and professional and need to be reported appropriately to avoid any ethical issues.

6. ***Approvals:*** One of the most important aspects of research that involves human or animal subjects is adhering to all the ethical approvals and legal guidelines. Non-compliance with this ethical mandate is considered a serious type of research misconduct.

Literature Review

- A literature review is a survey of scholarly sources (such as books, journal articles, and theses) related to a specific topic or research question.

- It is often written as part of a thesis, dissertation, or research paper, in order to situate your work in relation to existing knowledge.

- Literature reviews also must contain at least three basic elements:

  a) An Introduction or background information section;

  b) The body of the review contains the discussion of sources;

  c) and, finally, a conclusion and/or recommendations section to end the paper.

Literature Review

- ✓ A *description* of the publication;

- ✓ A *summary* of the publication's main points;

- ✓ A *discussion of gaps* in research; A

- ✓ *Evaluation* of the publication's contribution to the topic.

Types of Literature

1. Primary Literature

- ✓ Primary sources means original study, based on direct observation, use of statistical records, interviews, or experimental methods, of actual practices or the actual impact of practices or policies.

- ✓ They are authored by researchers, contain original research data, and are usually published in a peer-reviewed journal.

- ✓ Primary literature may also include conference papers, pre-prints, or preliminary reports.

Electronic Sources of Literature:

1. Internet
2. E-mail communication
3. Interviews (e.g., telephone, e-mail)
4. Video recordings (e.g. television programs)
5. Audio recordings (e.g. radio programs)
6. Web sites
7. Communications through social networking applications (e.g. Face book, blogs, RSS, U-tube etc.)

Literature Review

2. **Secondary Literature**

✓ Secondary literature consists of interpretations and evaluations that are derived from or refer to the primary source literature.

Examples include review articles (such as meta-analysis and systematic reviews) and reference works.

✓ Professionals within each discipline take the primary literature and synthesize, generalize, and integrate new research.

✓ A secondary source of information is one that was created by someone who did not have first-hand experience or did not participate in the events or conditions being researched.

✓ Secondary sources describe, analyze, interpret, evaluate, comment on and discuss the evidence provided by primary sources.

Literature Review

1. Biographical works
2. Commentaries
3. Criticisms
4. Histories
5. Journal articles (depending on the discipline, these can be primary)
6. Magazine and newspaper articles (this distinction varies by discipline)
7. Autobiography
8. Textbooks (also considered tertiary)
9. Websites (also considered primary)
10. Biographies, Encyclopaedias, dictionaries, handbooks
11. Textbooks
12. History & historical criticism

Literature Review

3. Tertiary Literature:

✓ Tertiary literature consists of the distillation and collection of primary and secondary sources such as textbooks, encyclopedia articles, and guidebooks or handbooks.

✓ The purpose of tertiary literature is to provide an overview of key research findings and an introduction to principles and practices within the discipline.

Literature Review

1. Classifications
2. Dictionaries
3. Encyclopaedias
4. Directories
5. Guidebooks and manuals
6. Population registers statistics
7. Factbooks
8. Abstracts
9. Indexes
10. Bibliographies
11. Manuals/Guide books

Technical reading

✓ A technical report is a document written by a researcher detailing the results of a project and submitted to the sponsor of that project.

Technical research paper should include the following:

1. **Title** should clearly communicate the topic.

2. **Abstract** should contain the high-level message of the whole research, it is advised to be done after completing the research – should contain a maximum of 300 words.

3. **Introduction** should explain the problem, firstly from the large or historical context, then explaining motivations and its impotence.

4. **Background and Motivation** might be separated from the introduction if there is a need to explain it widely.

5. **Sections with names of your choice** should divide the paper into logical parts of statements and evidences for example:
   1. what was done,
   2. what is the result,
   3. what are discussions around it.

6. **Discussion and Future Work** part should include further steps which can be done in the area, also some unsolved topics.

7. **Conclusion** should include summary of the findings.

8. **References** so all used literature in alphabetical order (by the last name of authors).

Contents

- Bibliographic Databases
- New and Existing Knowledge
- Analysis and Synthesis of Prior Art

BIBLIOGRAPHY

- ✓ It is a Greek word meaning —copying of books

- ✓ bibli (books) and graphia - graphy (writing)

- ✓ The concept was in practice by Greek writers in the first three centuries AD and was referred to as the copying of books by hand.

- ✓ By the turn of the 12th Century, the concept took a literal form and was referred to as the intellectual practice of compiling books and materials.

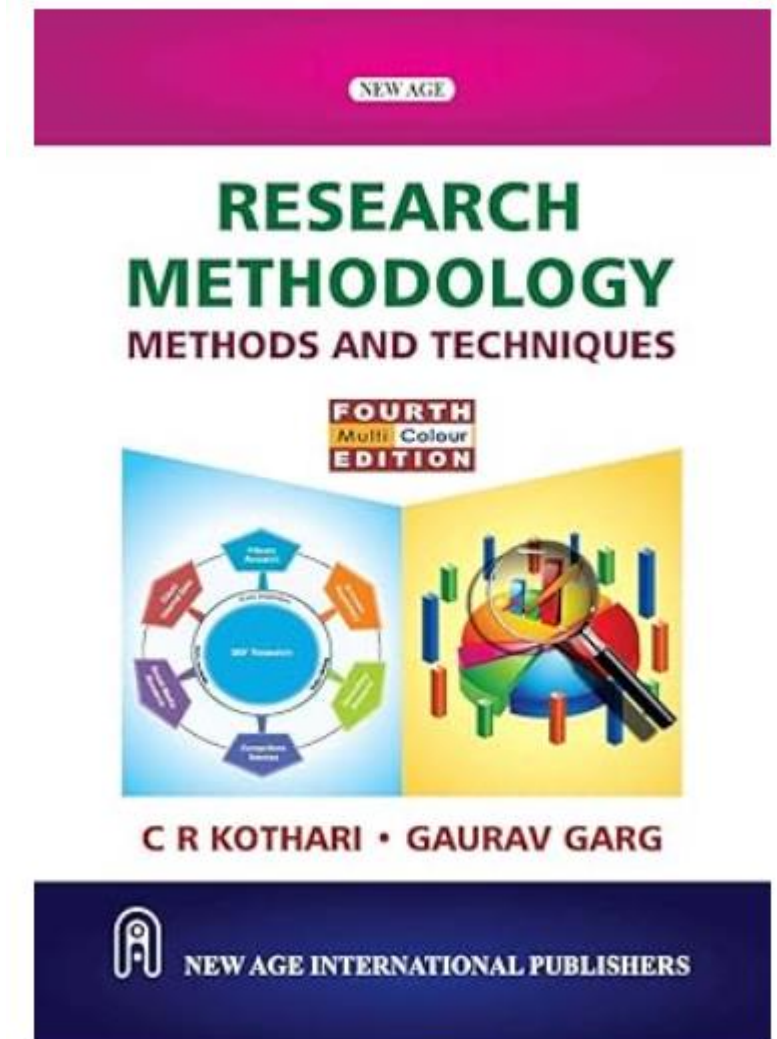- ✓ The modern-day notion of bibliographies, however, only took off in the 17th Century.

BIBLIOGRAPHY

- ✓ A bibliography is a list of all of the sources you have used (whether referenced or not) in the process of researching your work.

- ✓ In general, a bibliography should include: the authors' names, the titles of the works, the names and locations of the companies that published the copies of sources.

- ✓ The bibliography should give a clear, complete description of the sources that were used while preparing the report.

- ✓ It is an alphabetical list as per the author's surname.

Standard Bibliography Format

Bibliography Format for a Book: A standard bibliography for a book typically consists of the following information:
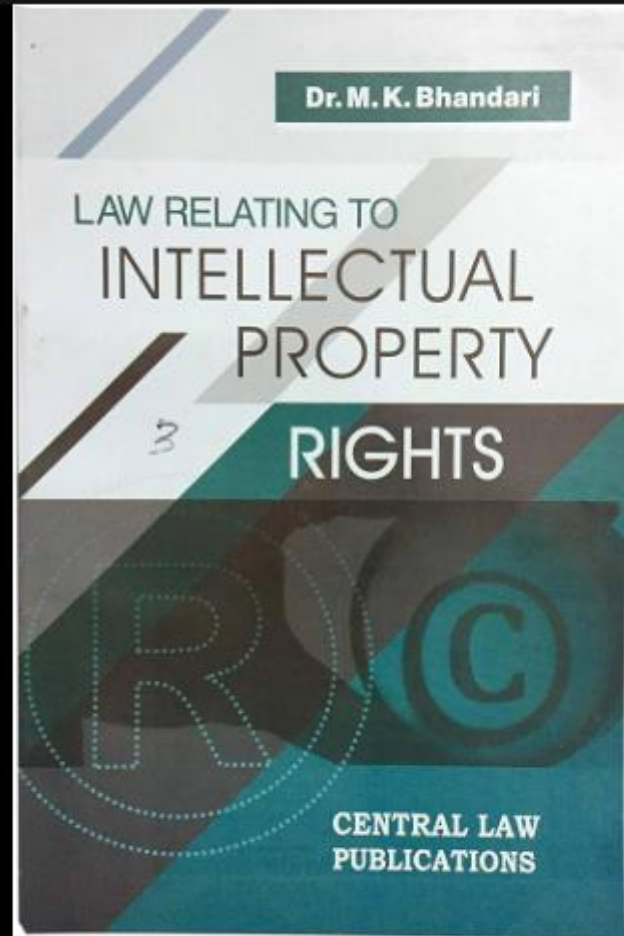
a) Author(s)
b) Title
c) Publisher
d) Date of Publication

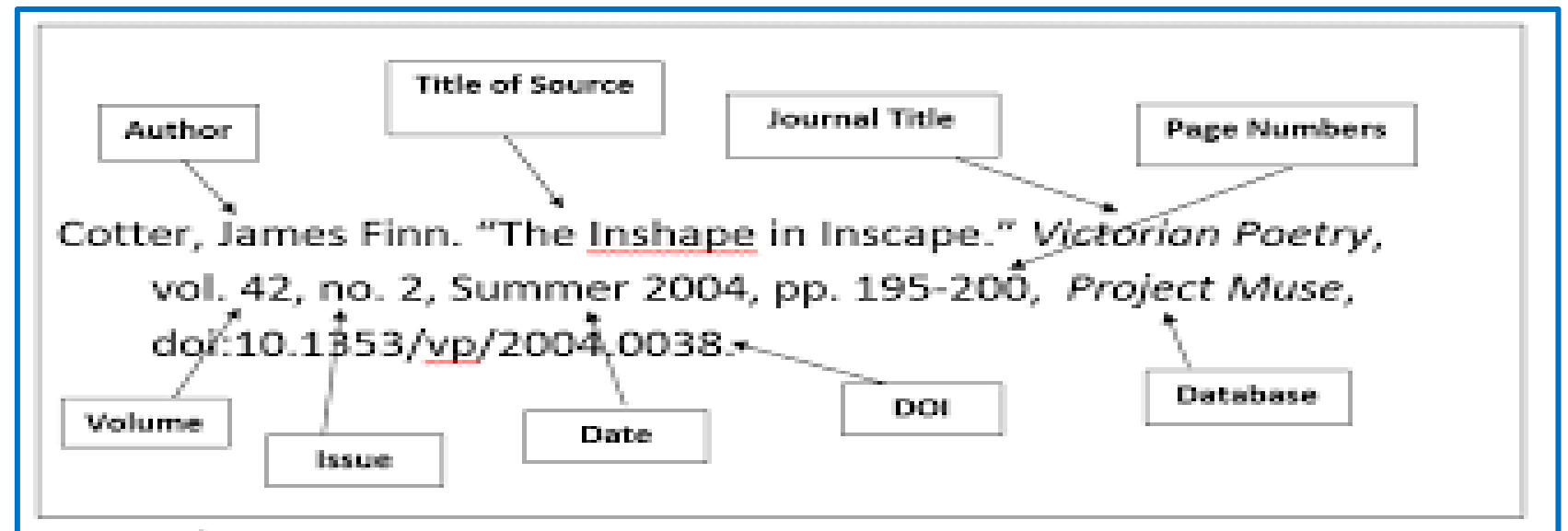Law Relating to Intellectual Property Rights
Paperback – 1 January 2017 (Publisher By Central La...

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Standard Bibliography Format

Bibliography Format for a Periodical & Journal Article: An entry for a journal or periodical article contains the following information:

a)   Author(s)
b)   Article Title
c)   Journal Title
d)   Volume Number
e)   Pages
f)   Date of Publication

Standard Bibliography Format

Academic Progress of Canadian Engineering Students in terms of MBTI Personality Type*

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E-mail prosati@julian.uwo.ca*

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Standard Bibliography Format

Bibliography Format for Internet Sources: Format for internet sources usually includes the following information:

a) Author (Website)
b) Article Title
c) Publication Information
d) Version
e) Date of Publication
f) Location (Digital Object Identifier – DOI or URL)

For 2-3 authors, list them with only the first author name inverted and the others in the correct order, separated by commas and 'and'.
For more than three authors, state the first author only followed by et al.
If the site is controlled by an organisation, use the organisation name.

This is only stated if needed.

Last name, first name. *Site Title*. Sponsoring institution/publisher. Publication date day month abbreviation. year, URL.

Month abbreviation includes Jan., Feb. etc.

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New and Existing Knowledge

- **New knowledge** in research can only be interpreted within the context of what is already known, and cannot exist without the foundation of existing knowledge.

- The new knowledge can have vastly different interpretations depending on the researcher's background, and one's perception of that new knowledge can change from indifference to excitement.

- One can infer that the knowledge that is sought to be produced does not yet exist by describing what other knowledge already exists and by pointing out that this part is missing so that what we have is original.

- To do this, one again needs the existing knowledge:
  - ✓ the context,
  - ✓ the significance,
  - ✓ the originality, and
  - ✓ the tools.

New and Existing Knowledge

Where does this existing knowledge come from?

- Normally, one finds this knowledge by reading and surveying the literature in the field that was established long ago and also about the more recent knowledge which is in fact always changing.

- With this foundation in place, the new knowledge that one will make will be much more difficult to challenge than without that strong foundation in place which is ensured with lots of references to the literature.

New and Existing Knowledge

- Often, but not always, the textbooks contain the older established knowledge and the research papers the newer work.
  - Reading the textbooks on one's topic provides the established knowledge and the background to be able to read the newer work usually recorded in the research papers.

- Very often, reading a textbook is not too difficult for it is written as a teaching instrument, and the author of the textbook normally starts from the basics and take the reader, through everything that one needs to be able to understand that topic.

- This is not at all the case with a research paper where the goal is normally to present a small piece of new knowledge, and that new knowledge will not have stood the test of time in the same way as the knowledge in a textbook would have.

New and Existing Knowledge

- The research paper is written for other researchers out on the edge of knowledge and it assumes that the reader already knows a lot in that field.

- It can be difficult to find the right work to read, but the objective with all this reading and learning is to be able to get the knowledge that one needs to build the foundation.

New and Existing Knowledge

- The review process must explain how a research item builds on another one

- This is because useful research should elucidate how and why certain technical development took place, so that it is easy for the reader to comprehend why the present talk is being undertaken, and a good literature survey would provide a convincing under to that question.

- An effective review of literature ensures a firm foundation for

  - ✓ advancing knowledge,

  - ✓ facilitates theoretical growth,

  - ✓ eliminates as areas that might be of interest, and

  - ✓ opens new avenues of possible work.

New and Existing Knowledge

- Generally, a good literature survey is the first expectation of a supervisor from the research student.

- A good literature review would not draw hasty conclusions and look into the individual references to determine the underlying causes/assumptions/mechanisms in each of them so as to synthesize the available information in a much more meaningful way.

- A literature review should be able to summarize as to what is already known from the state of the art,

  - detail the key concepts and

  - the main factors or parameters

  - identify the reported results that are inconclusive or contradictory, and

  - provide a compulsive reason to do further work in the field.

New and Existing Knowledge

A good literature survey is typically a two-step process as enumerated below:

(i) Identify the major topics or subtopics or concepts relevant to the subject under consideration.

(ii) Place the citation of the relevant source (article/patent/website/data, etc.) in the correct category of the concept/topic/subtopic (with the help of a , for example).

Analysis and Synthesis of Prior Art

- After collecting the sources, usually articles, intended to be used in the literature review, the researcher is ready to break down each article and identify the useful content in it.

- A literature survey grid of N topics and M sources is shown below to help crystallize the information in different categories.

	Source 1	Source 2	…	Source M
Topic 1		✓		
Topic 2	✓			✓
⋮				
⋮				
Topic N	✓	✓		

Analysis and Synthesis of Prior Art

(i) Understanding the hypothesis,

(ii) Understanding the models and the experimental conditions used,

(iii) Making connections,

(iv) Comparing and contrasting the various information, and

(v) Finding out the strong points and the loopholes.

Analysis and Synthesis of Prior Art

Here are a few criteria that could help the researcher in the evaluation of the information under study:

• Authority: What are the author's credentials and affiliation? Who publishes the information?

• Accuracy: Based on what one already knows about the topic or from reading other sources, does the information seem credible? Does the author cite other sources in a reference list or bibliography, to support the information presented?

• Scope: Is the source at an appropriate comprehension or research level?

Conceptualizing Research

- The characteristics of a research objective are that it must have new knowledge at the center, and that it must be accepted by the community of other researchers and recognized as significant.

But how do we actually conceptualize the research?

- Besides being original and significant, a good research problem should also be solvable or achievable.

- This requirement already asks us to think about the method and the tools that could be used to obtain that new knowledge.

Conceptualizing Research

- Coming up with a good research objective, conceptualizing the research that meets all of these requirements is a tough thing to do.

- It means that one must already be aware of what is in the literature.

- That is, by the time one actually has a good research objective, one is probably already an expert at the edge of knowledge else it is difficult to say with confidence that one has a good research objective.

- If one is doing research at the Ph.D. level or higher, then conceptualizing the research is probably something that one needs to do oneself.

- This is a very tough step because one needs to know all that literature in the field

Conceptualizing Research

- So, when working at the Ph.D. level, one needs to be prepared to become that expert, one needs to be continually reading the literature so as to bring together the three parts:

(i) significant problem,

(ii) the knowledge that will address it, and

(iii) a possible way to make that new knowledge.

- How these three aspects would come together will be different for every person doing research and it will be different in every field, but the only way to be that expert is by immersing oneself in the literature and knowing about what already exists in the field

Conceptualizing Research

- However, if one is working on a research project that is of a smaller scope than a Ph.D., let us say a master's thesis, then conceptualizing the research is possibly too tough to do, and one does not have the time that it takes to become that expert at the edge of knowledge.

- In this case, the researcher needs the help of someone else, typically the supervisor who may already be an expert and an active researcher in that field, and may advise on what a good research objective might be.

- An established researcher in any field should be able to immediately point to the landmark literature that one should read first.

- Otherwise one would need to spend a lot of time reading the literature to discover

Critical and Creative Reading

- Reading a research paper is a critical process.

- The reader should not be under the assumption that reported results or arguments are correct.

- Rather, being suspicious and asking appropriate questions is in fact a good thing.
  - Have the authors attempted to solve the right problem?
  - Are there simpler solutions that have not been considered?
  - What are the limitations (both stated and ignored) of the solution and are there any missing links?
  - Are the assumptions that were made reasonable?
  - Is there a logical flow to the paper or is there a flaw in the reasoning? These need to be ascertained apart from the relevance and the importance of the work, by careful reading

Critical and Creative Reading

- Use of a judgemental approach and boldness to make judgments is needed while reading.

- Flexibility to discard previous erroneous judgments is also critical.

- Additionally, it is important to ascertain whether the data presented in the paper is right data to substantiate the argument that was made in the paper and whether the data was gathered and interpreted in a correct manner.

Citations: Functions and Attributes

- Citations (references) credit others for their work
  - papers, patents, or presentations must be used in any new document only by clearly citing the source
  - texts, images, sounds, etc

- The growth of knowledge is primarily incremental and a researcher invariably and naturally builds upon prior information.

- There are well-established means of preventing and spreading knowledge through publication of patents, papers (conference paper and the peer-reviewed journal paper), articles, and textbooks and classrooms.

Citations: Functions and Attributes

- When a bibliography of previously published patents or papers is placed in the new works of a researcher, a connection is established between the new and previous work.

- Citations help the readers justification of the findings.

- Preferably, citations should be given at the end of a sentence or the end of a paragraph as can be seen even in this particular paragraph.

- Citation must contain enough details so that readers can easily find the referenced material

Citations: Functions and Attributes

- A researcher needs to cite each source twice:

 (i) in-text citation

(ii) a second time in the references

- may choose any style of one's choice as long as one is consistent.

- It is also important to mention the date the source was published

- LaTeX, a document preparation system often used by engineering researchers to automatically format documents that comply with standard formatting needs, is very effective in tracking and update citations.

Citations: Functions and Attributes

• There are three main functions of citation:

(i) Verification function: Authors have a scope for finding intentional or unintentional distortion of research or misleading statements.

(ii) Acknowledgment function: Researchers primarily receive credit for their work through citations.

(iii) Documentation function: Citations are also used to document scientific concepts and historical progress of any particular technology over the years

Citations: Functions and Attributes

- There are certain cases when references do not fulfill the actual goal of citations and acknowledgments

  1. Spurious citations: In certain cases, when the citation is not required or an appropriate one is not found, if the author nevertheless goes ahead with including one anyway, it would be considered as a spurious citation

  2. Biased citations: When authors cite the work of their friends or colleagues despite there being no significant connection between the two works.

  3. Self-citations: There is nothing wrong in citing one's prior work if the citation is really relevant. Self-citation of prior papers is natural because the latest paper is often part of a larger research project which is ongoing.

  4. Coercive citations: Despite shortcomings, impact factors remain a primary method of quantification of research,

Impact of Title and Keywords on Citations

- The citation rate of any research paper depends on various factors including significance and availability of the journal, publication types, research area, and importance of the published research work.

- Other factors like length of the title, type of the title, and selected keywords also impact the citation count

- It is the main indication of the research area or subject and is used by the researcher as a source of information during literature survey.

- A good title is informative, represents a paper effectively to readers, and gains their attention.
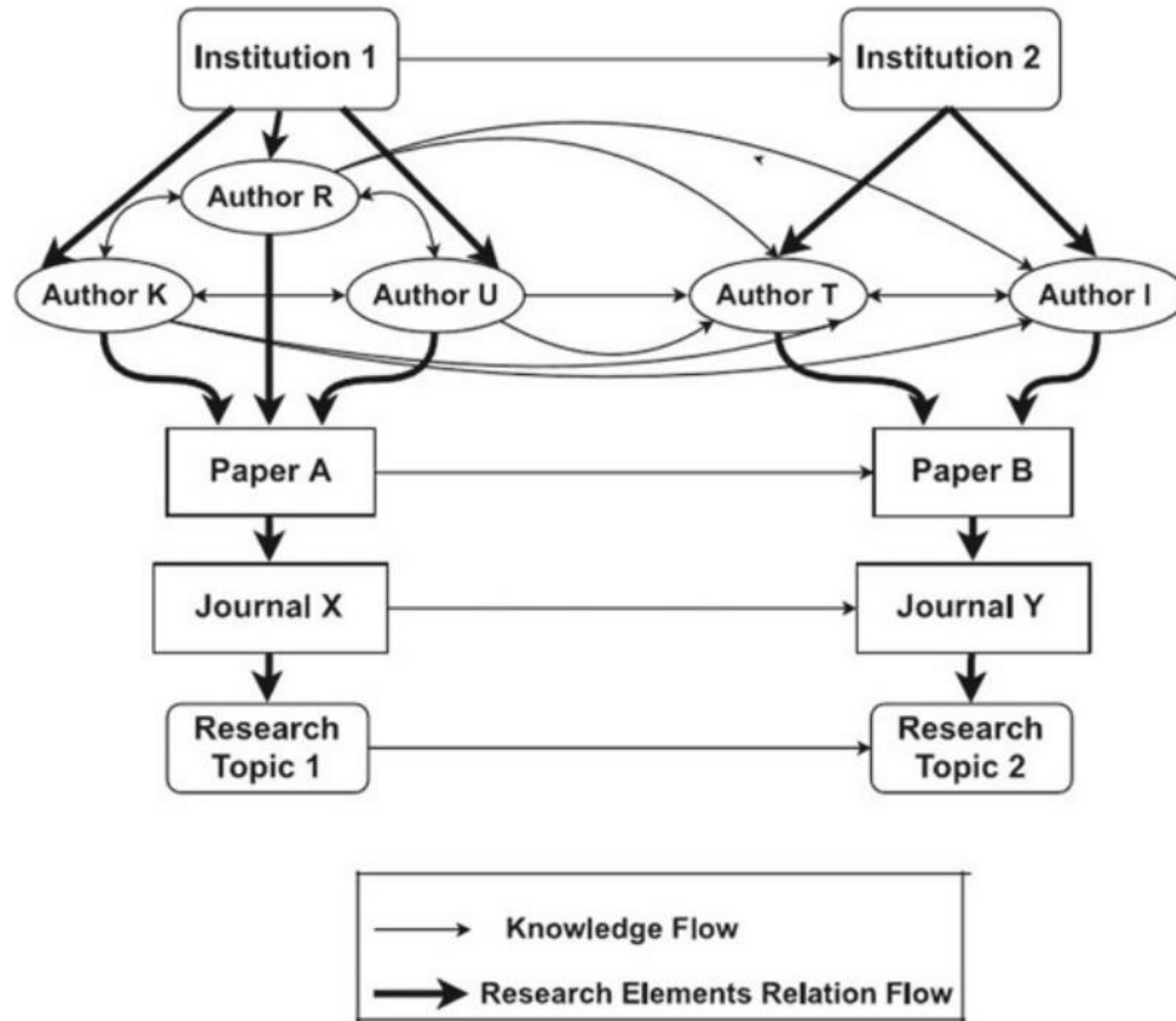
Impact of Title and Keywords on Citations

- The download count and citation of a research paper might be influenced by title.

- There are three different aspects which provide a particular behavior to the title:

  (i) types of the title,

  (ii) length of the title, and

  (iii) presence of specific markers

Impact of Title and Keywords on Citations

- Declarative titles are downloaded and cited less than descriptive titles

- Longer titles mainly include the study methodology and/or results in more detail, and so attract more attention and citations

- In general, titles containing a question mark, colon, and reference to a specific geographical region are associated with lower citation rates,

- Additionally, review articles and original articles usually receive more citations than short communication articles.

- At least two keywords in the title can increase the chance of finding and reading the article as well as get more citations.

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Knowledge Flow Through Citation

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Knowledge Flow Through Citation

- Figure 3.2 shows a relationship between co-authorship and different types of citations. Three articles (X, Y, and Z) and five references (X1, X2, X3, Y1, and Y2) of article X and Y, respectively, are considered. A, B, and C are authors of article X, and D, E, F, G, and also A are authors of article Y. Article Z has two authors H and E. References X1, X2, X3, Y1, and Y2 have authors (A, P), (H, R), (D), (Q, B, F), and (R), respectively.

Knowledge Flow Through Citation
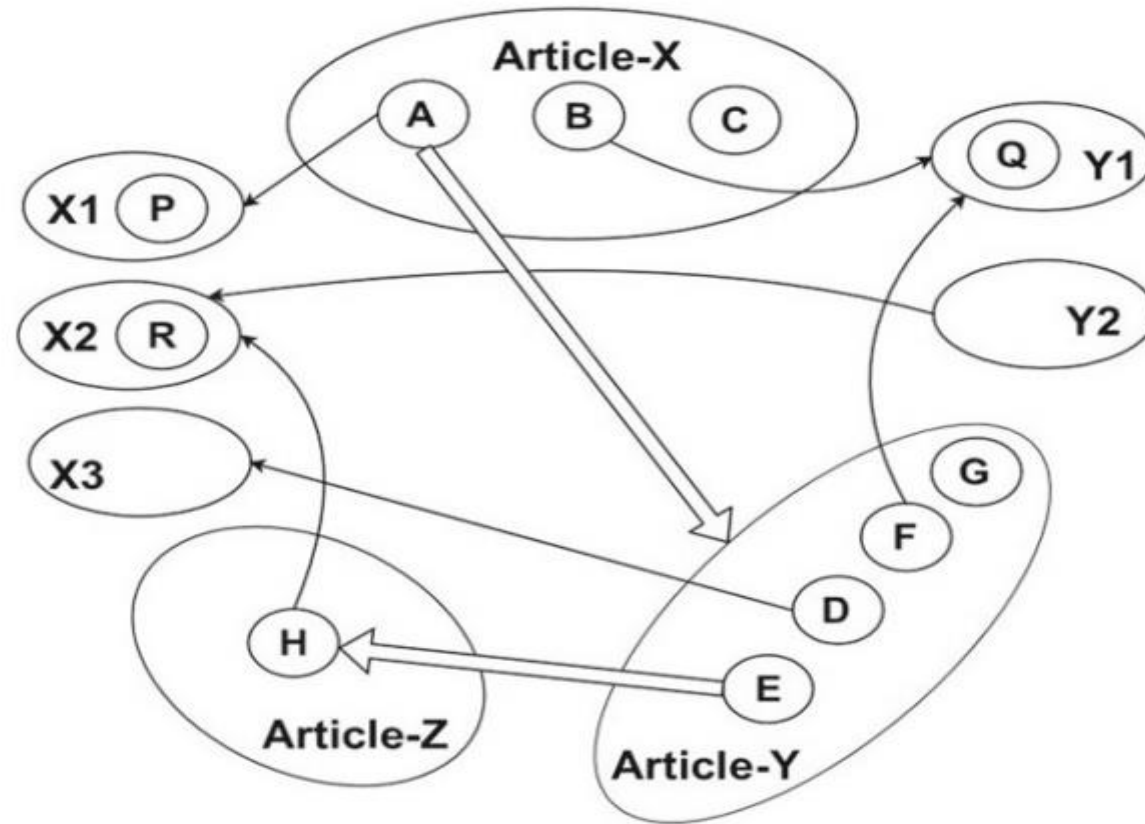
Citing Datasets

- Data citations must fetch proper credit to the creator of the dataset as citations of other objects like research articles.

- Data citations should have provisions to give credit and legal attribution to all contributors and enable identification and access while recognizing that a specific style may not apply to all data.

- A researcher should obtain the necessary permission to use data from a particular source.

- It is proper to include a mixture of general and specific information to enable a reader to be certain that the search result is the same dataset that was sought.

Citing Datasets

Examples:

1. Historical Data, Sotavento (Wind Farm), Corunna, Spain (July 2016): [Accessed: 4 Oct, 2016] Retrieved from http://www.sotaventogalicia.com/en/real-time-data/historical

2. Deb, D (2016). [Personnel survey]. Unpublished raw data.

Styles for Citations

- Citation styles differ primarily in the order, and syntax of information about references, depending on differences in priorities attributed to concision, readability, dates, authors, and publications.

- 1. ASCE style (American Society of Civil Engineers)

Template for books:
Author Surname, Author Initial. (Year Published). Title. Publisher, City, Pages Used.

Example:
Wearstler, K., and Bogart, J. (2004). Modern glamour. Regan Books, NY.

Template for websites:
Author Credentials / Company Name (Year Published). 'Title'. http://Website URL (Oct. 10, 2013).

Example:
Blade cleaning services (2015): http://www.bladecleaning.com/problematica (29 Oct, 2016).

Template for journal publications:
Author Surname, Author Initial. (Year Published). 'Title'. Publication Title, Volume number(Issue number), Pages Used.

Example:
Johnston, L. (2014). "How an Inconvenient Truth Expanded The Climate Change Dialogue abd Reignited An Ethical Purpose in The United States". 1—160.

Styles for Citations

(b) In-text citation for journals or books: The following part is to be placed right after the reference to the source of the citation assignment:

Template
_____
(Author Surname/Website URL Year Published)

Examples:
  i. Citation is a very important part of technical writing. (Deb 2016)
 ii. Engineers create devices to monitor mountains so that nearby inhab-
     itants can be warned of impending eruptions. (Teachengineering.org
     2014)

Styles for Citations

2. IEEE style (Institute of Electrical and Electronics Engineers)

IEEE style is standard for all IEEE journals and magazines, and is frequently used for papers and articles in the fields of electrical engineering and computer science. The IEEE style requires endnotes and that references be cited numerically in the text.

Chapter in an edited book
[1] A. Rezi and M. Allam, "Techniques in array processing by means of transformations,"
in Control and Dynamic Systems, Vol. 69, Multidimensional Systems, C. T. Leondes,
Ed. San Diego: Academic Press, 1995, pp. 133–180.

3. ASME style (The Association of Mechanical Engineers)

Acknowledgments and Attributions

- Acknowledgment section is a place to provide a brief appreciation of the contribution of someone or an organization or funding body to the present work.
- If no particular guideline is available for the intended publication, then it can be introduced at the end of the text or as a footnote.
- Acknowledgment displays a relationship among people, agencies, institutions, and research.
- As a sign of gratitude, such contributions should be acknowledged.
- Classification of acknowledgment into six different categories like moral, financial, editorial, institutional or technical, and conceptual support.
- even if the contribution is minor, it should not be neglected
- Whenever possible, author shall give name of persons who may be responsible, even if nominally, for designs, inventions, writings, or other accomplishments.

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What Should Be Acknowledged?

- Every author should know **what should/should not be acknowledged.**
- Author should acknowledge
  - quotation, ideas, facts, paraphrasing, funding organization, oral discussion or support, laboratory, and computer work.

(i) **Quotation:** In technical writing such as in the field of engineering, quotes are used very rarely. Quotations are of **two types:**

    (a) **Direct quotations** are used when the author use actual words or sentences in the same order as the original one.

    (b) **Indirect quotation** summarizes or paraphrases the actual quote. In such cases, it is important to acknowledge with proper name and date

What Should Be Acknowledged?

- (ii) Authors should acknowledge people who give appropriate contributions in their research work. Non-research work contributions are not generally acknowledged in a scientific paper but it may be in a thesis.
    - Authors should acknowledge assistants, students, or technicians, who helped experimentally and theoretically during the research work.
- (iii) If the researcher received a grant from a funding agency and if those funds were used in the work reported in the publication,
- Failure to acknowledge funding may result in the discontinuation of current funding and/or ineligibility to receive future funding for a certain number of years or indefinitely

Acknowledgments in Books/Dissertations

Sample Acknowledgement in Thesis:

I wish to express my sincere appreciation to my supervisor Prof. Gang Tao for the useful comments, remarks and encouragement throughout this thesis work. Furthermore, I wish to express my thanks to Prof. Jacob Hammer for introducing me to the topic and for the support along the way. Also, I like to thank my peers in the Adaptive Control Lab such as Yu Liu and Shanshan Li, who have shared their precious time during many lively technical discussions. I would like to thank my family members who have supported me throughout this journey in many different ways.

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"Science is not belief, but the will to find out."

Thank you

Akshata S Bhayyar, Asst. Prof, Dept. of CSE, RIT