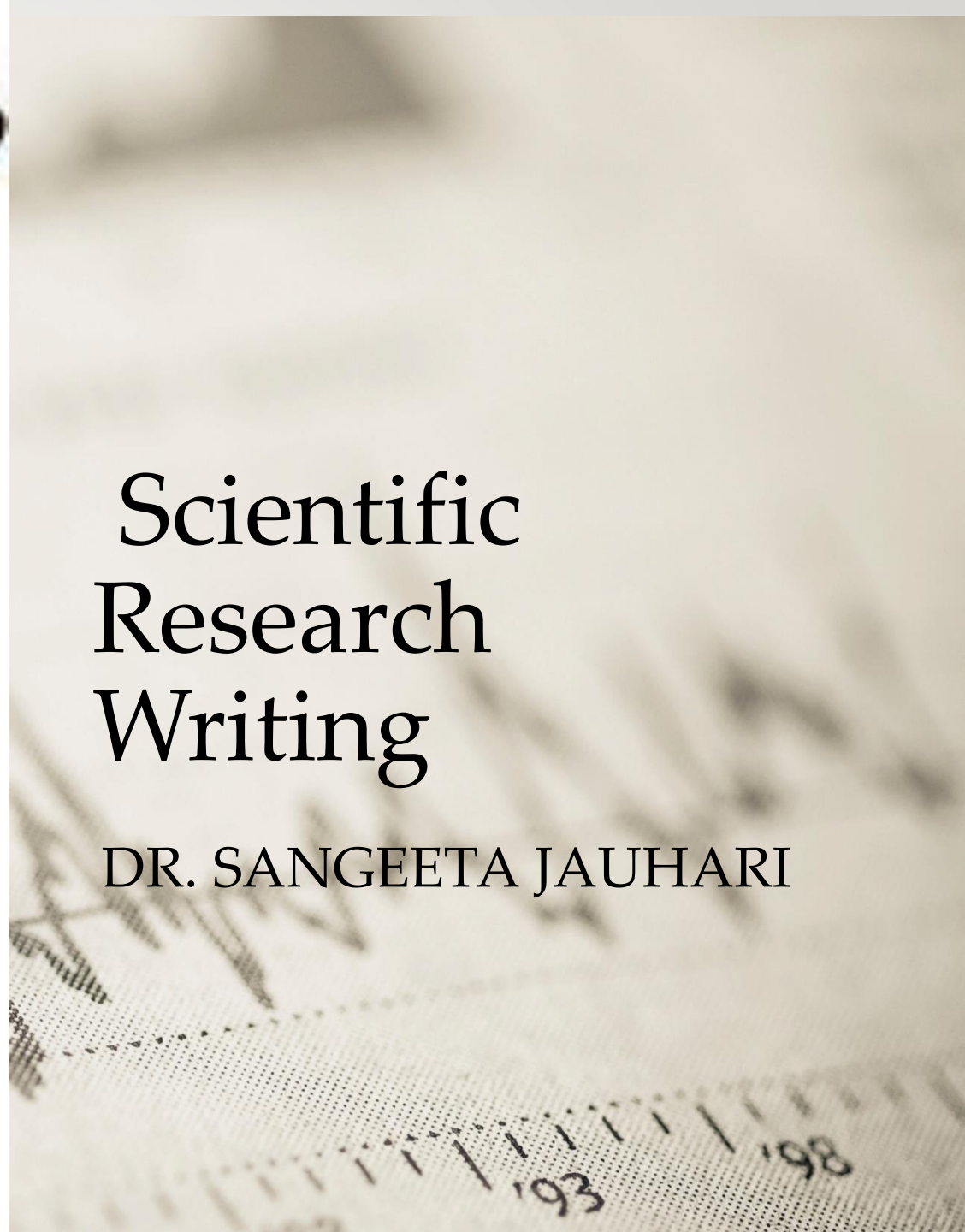
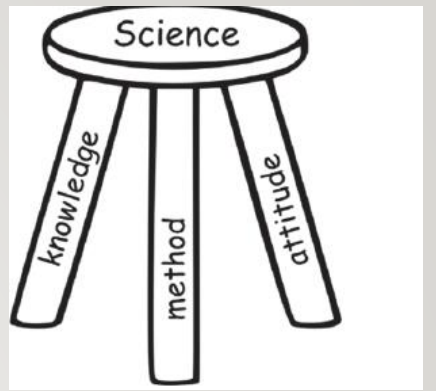




Scientific Research Writing

DR. SANGEETA JAUHARI





2

Three Pillars of Science

- Science can be thought of as the combination of three essential things:
 - (1) Knowledge- can be collected through facts /data and theories ;
 - (2) Method- Evaluation of theories by comparing the predictions of those theories to observation/experiment; and to find out the inferences out of it.
 - (3) Attitude- an **attitude of unconvinced inquiry** and the belief that all scientific knowledge is provisional and subject to revision when confronted with new evidence.

3

What is Scientific Research & Why Scientific Research

- Research is known as journey from unknown to known.
- 'Scientific Research is a systematic, controlled and critical investigation of propositions about various phenomena'.(Fred Kerlinger 1986)
- *Scientific research is required to ;*
- *validate existing postulates*
- *Critical evaluation of existing theories and postulates*
- *arriving at new theories and models.*

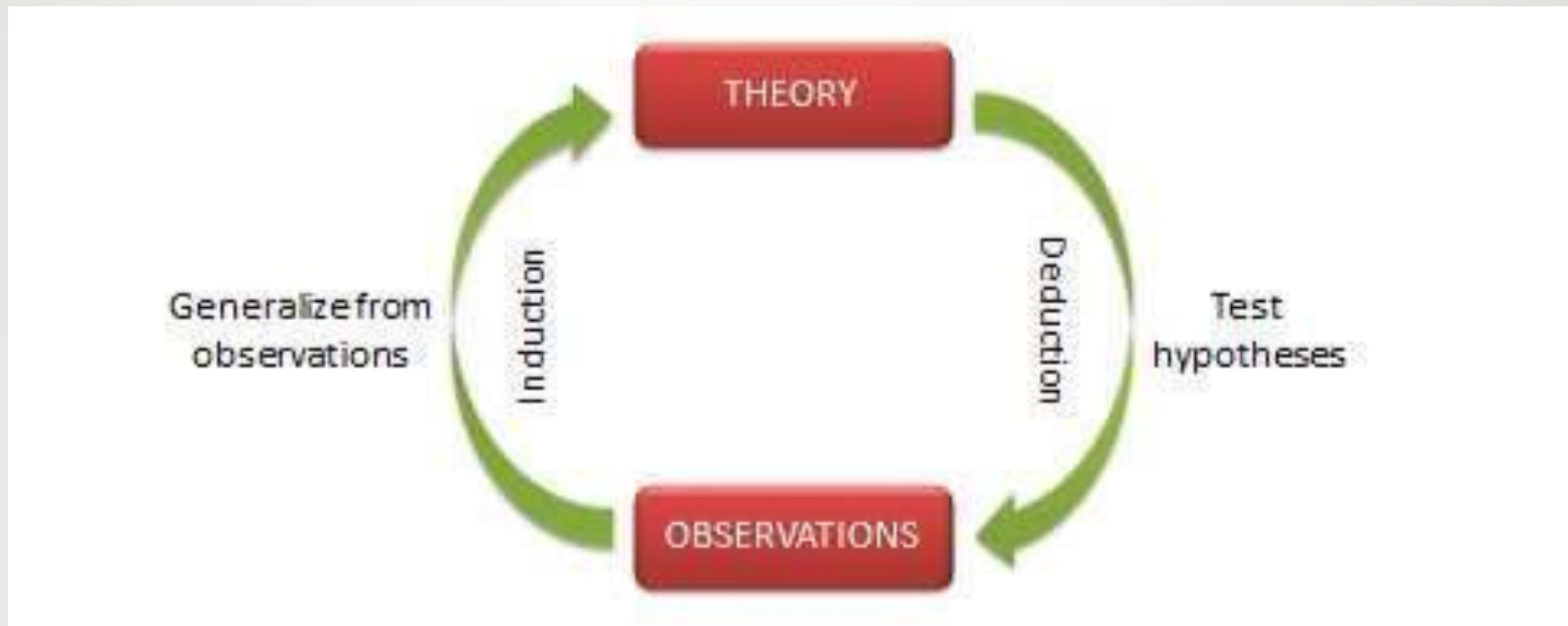
4 | Basis of Scientific Approach to Research

The scientific method is based on certain “articles of faith” which are:

- ▶ Logical reasoning process (Deduction, Induction and Abduction)
- ▶ Reliance on empirical evidence
- ▶ Use of relevant concepts
- ▶ Commitment to objectivity
- ▶ Ethical neutrality
- ▶ Generalization
- ▶ Verifiability

5

Deductive and Inductive Approach/Reasoning



6

Abductive Reasoning

- The third method of reasoning, *abduction*, is defined as "a sylllogism in which the major premise is evident but the minor premise and therefore the conclusion only probable."
- Basically, it involves forming a conclusion from the information that is known. A familiar example of abduction is a detective's identification of a criminal by piecing together evidence at a crime scene.
- If you have trouble differentiating *deduction*, *induction*, and *abduction*, thinking about their roots might help. All three words are based on Latin *ducere*, meaning "to lead."
- The prefix de- means "from," and deduction derives *from* generally accepted statements or facts. The prefix in- means "to" or "toward," and induction leads you *to* a generalization. The prefix ab- means "away," and you take *away* the best explanation in abduction.

7 | What is a Research Paper?

- A research paper is a written work which involves the processes of researching, critical thinking, source evaluation, composition and organization.
- The readers must be not only able to read it but also analyse it.
- Scientific papers must be **written clearly, concisely and precisely** so that readers with backgrounds similar to yours can understand easily what you have done and how you have done it should they want to repeat or extend your work.
- **A Scientific Paper should be a well-structured and comprehensive manuscript for a publication submission.**

A Scientific Research Paper

- A scientific paper is a written and published report describing *original research results*. (Prof. Garry Dillard)
- A scientific experiment is not complete until the results have been published and understood.
- As Robert Day says in *How to Write and Publish a Scientific Paper* (1998), “The goal of scientific research is publication.... A scientific experiment, no matter how spectacular the results, is not complete until the results are published.”
- In fact, “the cornerstone of the philosophy of science is based on the fundamental assumption that original research must be published; only then can new scientific knowledge be authenticated and added to the existing database called scientific knowledge” (Bartow).

Purpose of Writing a Scientific Research Paper

- The purpose of scientific writing is to communicate new scientific findings
- Thus it has to be clear, simple and well ordered communication to transmit new scientific findings
- Knowledge is lost without written records
- Knowledge could be widely circulated through publication, with no effective duplication

Differences between Research Papers in Science and Research Papers in Humanities

- At the Dartmouth Writing Program, Karen Gocsik describes the purpose of writing a science paper as the search for truth, to find *one* correct answer to a problem. Additionally, scientists and researchers write for two reasons:
 - 1) to inform the community of new discoveries; and
 - 2) to help the scientific community arrive at a consensus about the truth.
- Published science papers measure and describe various observations and phenomenon and follow a more rigid format.
- Gocsik notes that “It is not important when writing a scientific paper to be eloquent. It is absolutely important, however, that you be clear.”

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Differences between Research Papers in Science and Research Papers in Humanities

- In Humanities, often the focus of the paper is on the interpretation of texts, not on the interpretation of hard evidence. Paragraphs and sentences are usually longer and more eloquent.
- Papers may include imagery, sensory detail, and the use of metaphors.
- Voice is active, not passive.
- English and humanities papers are based on arguments (a thesis statement), in which writers attempt to convince their readers that the claims being made about the topic or a text in question are valid.
- The purpose of such papers is to persuade the reader and to provide compelling examples or instances to back up the thesis statement. Oftentimes, these papers are short (4-6 pages) in length.

What is not a Research Paper?

- It is **not merely a depository of quotations**. Quotations take place only to document or clarify findings.
- It is **not a rewriting of someone's thoughts or ideas**. A research paper is not a description or summary of the facts from textbooks or the Internet.
- It is **not a defence of your opinion**. The aim of every research paper is to reveal the truth. Avoid fighting the opposite opinion (unless you need to write a persuasive paper.)
- It is **not a simple presentation of one's point of view**. Research papers demand facts, information, and data which support a certain opinion or idea.
- It is **not emotional persuasion**. Vocabulary that is used in research papers should be neutral and free of emotional language and superlatives.

Scientific Approach to Research

- Develop the Problem
- Reviewing the literature
- Framing of objectives
- Formulate the Hypothesis or Research Question
- Formulate the Research Plan (research Design)
- Collecting data
- Analyzing Data
- Refine the Theory if necessary
- Interpret the results and form the conclusions
- Reporting the Results

Develop the problem or selection of Topic :

- a. A topic is the main organizing principle guiding the analysis of your research paper/thesis/dissertation. Topics represent the core subject matter of scholarly communication, and the means by which we arrive at other topics of conversations and discover new knowledge.
- b. Observe your surroundings for new ideas and concepts
- c. Analyze your interest related to your subject area.
- d. 4P's (People, Process, Phenomena, Programme) act as a source to select the topic for research writing
- Narrow down the topic to be more focused

Literature Review

- **The purpose of a literature review is to:**
- Place each work in the context of its contribution to the understanding of the research problem being studied,
- Describe the relationship of each work to the others under consideration,
- Identify new ways to interpret, and shed light on any gaps in previous research,
- Identify areas of prior scholarship to prevent duplication of effort,
- Point the way in fulfilling a need for additional research, and
- Locate your own research within the context of existing literature.

Scientific Literature Review

Scientific Literature Review:

A scientific literature review is a *critical* account of what has been published on a topic by accredited researchers.

It may be:

- A stand-alone assignment
- An introduction to an essay, report, thesis, etc.
- Part of research/grant proposals

2. Reviewing the literature -

Scientific Literature Review:

How to structure a scientific literature review?

- **Introduction:** An *overview* of the topic under consideration, along with the *objectives* of the literature review.
- **Main body:** Critical analysis, evaluation of topically relevant research/data; Break into **sub-headings**
- **Conclusion:** Summarise the **key points** from your review

Word count:

Introduction = 10%
Main Body = 80-85%
Conclusion = 5-10%

Research Gap

- Literature Review Section must be concluded with the identification of the Research Gap: The Gap between What is Done in Past Studies and what is Proposed to be done in the Current Study.
- This helps to justify the significance /Rationale of the current study and its contribution to the existing arena of knowledge in the respective field of study.

Framing of Objectives

- Should be specific and clear
- Exploratory Research Quantitative in nature
- To analyze...
- To Examine....
- To Investigate
- To Evaluate

Exploratory Research and Qualitative in nature

- To Understand
- To Discover
- To explore

- Descriptive Research quantitative in nature
- To Know
- To study
- To find out
- To Describe

Formulate the Hypothesis

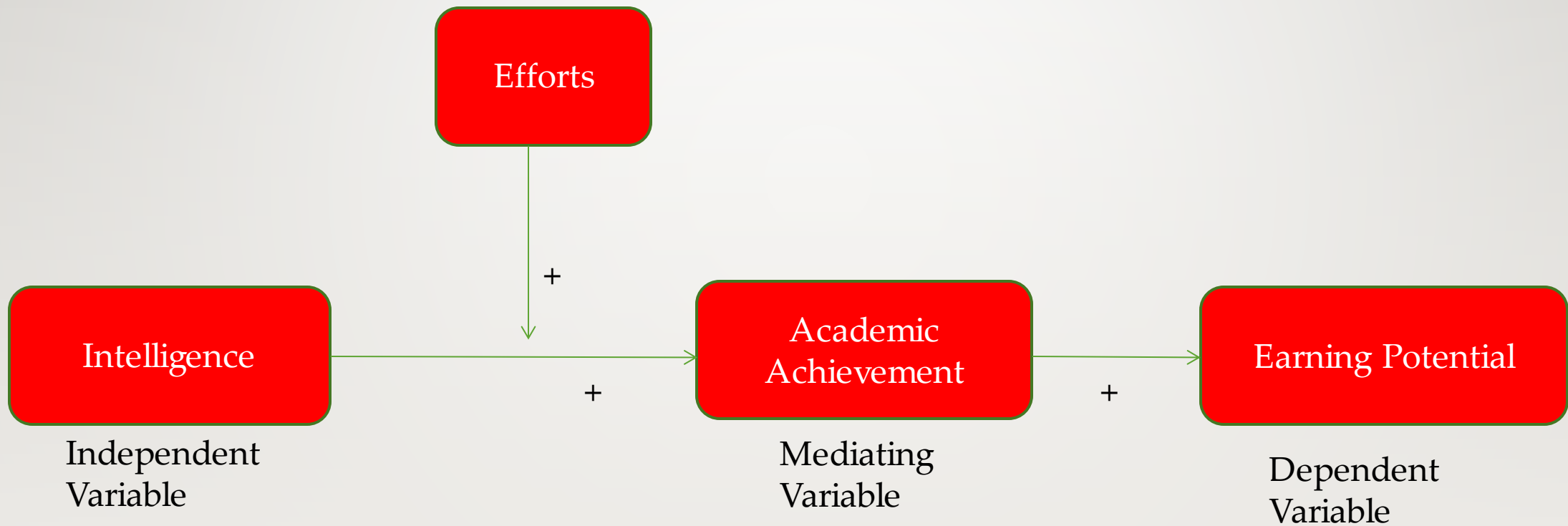
- Hypothesis – A conjectural statement of the relationship between two or more then two variables
- A hypothesis can be descriptive, directional , relational .
- Hypothesis Example :
- Relational -“ An increase in students’ IQ score causes an increase in their grade point average “-
- “An increase in student intelligence causes an increase in their academic achievement “

- Directional Hypothesis - There is a relation between quality of working life and job satisfaction experienced by employees.
- Descriptive Hypothesis – The literacy rate in Kerala is 100 percent .
- For testing of hypothesis the researcher develops ;
 - 1. Null hypothesis
 - 2. Alternate Hypothesis

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A network of Construct

Moderating
Variable.



- If we believe that intelligence influences (or explains) students' academic achievement, then a measure of intelligence such as an IQ score is an independent variable, while a measure of academic success such as grade point average is a dependent variable. If we believe that the effect of intelligence on academic achievement also depends on the effort invested by the student in the learning process (i.e., between two equally intelligent students, the student who puts in more effort achieves higher academic achievement than one who puts in less effort), then effort becomes a moderating variable. Incidentally, one may also view effort as an independent variable and intelligence as a moderating variable. If academic achievement is viewed as an intermediate step to higher earning potential, then earning potential becomes the dependent variable for the independent variable academic achievement, and academic achievement becomes the mediating variable in the relationship between intelligence and earning potential.

Choosing a Research Design

Research Design

- **Beginning your paper, you need to decide how you plan to design the study.**
- The research design refers to the overall strategy that you choose to integrate the different components of the study in a coherent and logical way, thereby, ensuring you will effectively address the research problem; it constitutes the blueprint for the collection, measurement, and analysis of data.
- Note that your research problem determines the type of design you can use, not the other way around!

Research Design

- The function of a research design is to ensure that the evidence obtained enables you to effectively address the research problem as unambiguously as possible. A sound research design will do the following things:
- Identify the research problem clearly and justify its selection,
- Review previously published literature associated with the problem area,
- Clearly and explicitly specify hypotheses [i.e., research questions] central to the problem selected,
- Effectively describe the data which will be necessary for an adequate test of the hypotheses and explain how such data will be obtained, and
- Describe the methods of analysis which will be applied to the data in determining whether or not the hypotheses are true or false.

Types of Research Designs

There are various types of Research Designs available in Literature:

- Action Research Design
- Case Study Design
- Causal Design
- Cohort Design
- Cross-Sectional Design
- Descriptive Design
- Experimental Design
- Exploratory Design

Types of Research Designs

- Historical Design
- Longitudinal Design
- Observational Design
- Philosophical Design
- Sequential Design
- Meta-Analysis Design
- Field Design
- Mixed Methods Design

Action Research Design

- The essentials of action research design follow a characteristic cycle whereby initially an exploratory stance is adopted, where an understanding of a problem is developed and plans are made for some form of interventionary strategy.
- Then the intervention is carried out (the action in Action Research) during which time, pertinent observations are collected in various forms.
- The new **interventional strategies** are carried out, and the cyclic process repeats, continuing until a sufficient understanding of (or implement able solution for) the problem is achieved.
- The protocol is **iterative or cyclical in nature** and is intended to foster deeper understanding of a given situation, starting with conceptualizing and particularizing the problem and moving through several interventions and evaluations.

Case Study Design

- A case study is an **in-depth study of a particular research problem** rather than a sweeping statistical survey. It is often used to narrow down a very broad field of research into one or a few easily researchable examples.
- The case study research design is also useful for testing whether a specific theory and model actually applies to phenomena in the real world. It is **a useful design when not much is known about a phenomenon.**

Causal Design

- Causality studies may be thought of as understanding a phenomenon in terms of conditional statements in the form, “If X, then Y.” This type of research is used to measure what impact a specific change will have on existing norms and assumptions. Most social scientists seek causal explanations that reflect tests of hypotheses.
- Causal effect (nomothetic perspective) occurs when variation in one phenomenon, an independent variable, leads to or results, on average, in variation in another phenomenon, the dependent variable.
- Conditions necessary for determining causality:
- Empirical association--a valid conclusion is based on finding an association between the independent variable and the dependent variable.
- Appropriate time order--to conclude that causation was involved, one must see that cases were exposed to variation in the independent variable before variation in the dependent variable.
- Non-spuriousness--a relationship between two variables that is not due to variation in a third variable.

Cohort Design

- Often used in the medical sciences, but also found in the applied social sciences, a cohort study generally refers to a study conducted over a period of time involving members of **a population which the subject or representative member comes from, and who are united by some commonality or similarity.**
- Using a quantitative framework, a cohort study makes note of statistical occurrence within a specialized subgroup, united by same or similar characteristics that are relevant to the research problem being investigated, rather than studying statistical occurrence within the general population.
- Using a qualitative framework, cohort studies generally gather data using methods of observation. Cohorts can be either "open" or "closed."
- Given this, the number of study participants remains constant (or can only decrease).

Cohort Design

- Open Cohort Studies involve a dynamic population that is defined just by the state of being a part of the study in question (and being monitored for the outcome). Date of entry and exit from the study is individually defined, therefore, the size of the study population is not constant.
- In open cohort studies, researchers can only calculate rate based data, such as, incidence rates and variants thereof.
- Closed Cohort Studies involves a static populations, involve participants who enter into the study at one defining point in time and where it is presumed that no new participants can enter or exit the cohort.

Cross-Sectional Design

- Cross-sectional research designs have three distinctive features: **no time dimension, a reliance on existing differences** rather than change following intervention; **and, groups are selected based on existing differences rather than random allocation.**
- The cross-sectional design can only measure differences between or from among a variety of people, subjects, or phenomena rather than change.
- As such, researchers using this design can only employ a relative passive approach to making causal inferences based on findings.

Descriptive Design

- Descriptive research designs help provide answers to the questions of who, what, when, where, and how associated with a particular research problem; a descriptive study cannot conclusively ascertain answers to why.
- Descriptive research is used to obtain information concerning the current status of the phenomena and to describe "what exists" with respect to variables or conditions in a situation.

Experimental Design

- A blueprint of the procedure that enables the researcher to maintain control over all factors that may affect the result of an experiment. In doing this, the researcher attempts to determine or predict what may occur.
- Experimental Research is often used where there is time priority in a causal relationship (cause precedes effect), there is consistency in a causal relationship (a cause will always lead to the same effect), and the magnitude of the correlation is great.
- The classic experimental design specifies an experimental group and a control group.
- The independent variable is administered to the experimental group and not to the control group, and both groups are measured on the same dependent variable.
- Subsequent experimental designs have used more groups and more measurements over longer periods. True experiments must have control, randomization, and replication.

Exploratory Design

- An exploratory design is conducted about a research problem when there are few or no earlier studies to refer to. The focus is on gaining insights and familiarity for later investigation or undertaken when problems are in a preliminary stage of investigation.
- The goals of exploratory research are intended to produce the following possible insights:
- Familiarity with basic details, settings and concerns.
- Well grounded picture of the situation being developed.
- Generation of new ideas and assumption, development of tentative theories or hypotheses.
- Determination about whether a study is feasible in the future.
- Issues get refined for more systematic investigation and formulation of new research questions.
- Direction for future research and techniques get developed.

Historical Design

- The purpose of a historical research design is to collect, verify, and synthesize evidence from the past to establish facts that defend or refute your hypothesis.
- It uses secondary sources and a variety of primary documentary evidence, such as, logs, diaries, official records, reports, archives, and non-textual information [maps, pictures, audio and visual recordings].
- The limitation is that the sources must be both authentic and valid.

Longitudinal Design

- A longitudinal study follows the same sample over time and makes repeated observations.
- With longitudinal surveys, for example, the same group of people is interviewed at regular intervals, enabling researchers to track changes over time and to relate them to variables that might explain why the changes occur.
- Longitudinal research designs describe patterns of change and help establish the direction and magnitude of causal relationships.
- Measurements are taken on each variable over two or more distinct time periods. This allows the researcher to measure change in variables over time.
- It is a type of observational study and is sometimes referred to as a panel study.

Observational Design

- This type of research design **draws a conclusion by comparing subjects against a control group, in cases where the researcher has no control over the experiment.** There are two general types of observational designs.
- In direct observations, people know that you are watching them.
- Unobtrusive measures involve any method for studying behaviour where individuals do not know they are being observed.
- An observational study allows a useful insight into a phenomenon and avoids the ethical and practical difficulties of setting up a large and cumbersome research project.

Philosophical Design

- Understood more as a broad approach to examining a research problem than a methodological design, philosophical analysis and argumentation is intended to challenge deeply embedded, often intractable, assumptions underpinning an area of study.
- This approach uses the tools of argumentation derived from philosophical traditions, concepts, models, and theories to critically explore and challenge, These overarching tools of analysis can be framed in three ways:
 - **Ontology** -- the study that describes the nature of reality; for example, what is real and what is not, what is fundamental and what is derivative?
 - **Epistemology** -- the study that explores the nature of knowledge; for example, on what does knowledge and understanding depend upon and how can we be certain of what we know?
 - **Axiology** -- the study of values; for example, what values does an individual or group hold and why? How are values related to interest, desire, will, experience, and means-to-end? And, what is the difference between a matter of fact and a matter of value?

Sequential Design

- Sequential research is that which is carried out in a deliberate, staged approach [i.e. serially] where one stage will be completed, followed by another, then another, and so on, with the aim that each stage will build upon the previous one until enough data is gathered over an interval of time to test your hypothesis.
- The sample size is not predetermined. After analysing each sample, the researcher can accept the null hypothesis, accept the alternative hypothesis, or select another pool of subjects and conduct the study once again.
- This means the researcher can obtain a limitless number of subjects before finally making a decision whether to accept the null or alternative hypothesis. Using a quantitative framework, a sequential study generally utilizes sampling techniques to gather data and applying statistical methods to analyze the data.
- Using a qualitative framework, sequential studies generally utilize samples of individuals or groups of individuals [cohorts] and use qualitative methods, such as interviews or observations, to gather information from each sample.

Meta- Analysis Design

- Meta -analysis is an analytical methodology designed to systematically evaluate and summarize the results from a number of individual studies, thereby, increasing the overall sample size and the ability of the researcher to study effects of interest.
- The purpose is to not simply summarize existing knowledge, but to develop a new understanding of a research problem using synoptic reasoning.
- The main objectives of meta-analysis include analyzing differences in the results among studies and increasing the precision by which effects are estimated.

Field Design

- Sometimes referred to as **ethnography or participant observation**, designs around field research encompass a variety of interpretative procedures [e.g., observation and interviews] rooted in **qualitative approaches** to studying people individually or in groups while inhabiting their natural environment as opposed to using survey instruments or other forms of impersonal methods of data gathering.
- Information acquired from observational research takes the form of “**field notes**” that involves documenting what the researcher actually sees and hears while in the field.
- Findings do not consist of conclusive statements derived from numbers and statistics because **field research involves analysis of words and observations of behaviour**. Conclusions, therefore, are developed from an interpretation of findings that reveal overriding themes, concepts, and ideas.

Mixed Methods Design

- Mixed methods research represents more of an approach to examining a research problem than a methodology.
- Mixed method is characterized by a focus on research problems that require, 1) an examination of real-life contextual understandings, multi-level perspectives, and cultural influences; 2) an intentional application of rigorous quantitative research assessing magnitude and frequency of constructs and rigorous qualitative research exploring the meaning and understanding of the constructs; and, 3) an objective of drawing on the strengths of quantitative and qualitative data gathering techniques to formulate a holistic interpretive framework for generating possible solutions or new understandings of the problem.
- Tashakkori and Creswell (2007) and other proponents of mixed methods argue that the design encompasses more than simply combining qualitative and quantitative methods but, rather, reflects a new "third way" epistemological paradigm that occupies the conceptual space between positivism and interpretivism.

Design Flaws to Avoid

- The research design establishes the decision-making processes, conceptual structure of investigation, and methods of analysis used to address the central research problem of your study.
- Taking the time to develop a thorough research design helps to organize your thoughts, set the boundaries of your study, maximize the reliability of your findings, and avoid misleading or incomplete conclusions.
- Therefore, if any aspect of your research design is flawed or under-developed, the quality and reliability of your final results and, by extension, the overall value of your study will be weakened.

Common problems to avoid when designing a research study.

- **Lack of Specificity** -- do not describe aspects of your study in overly-broad generalities. It is important that you design a study that describes the process of investigation in clear and concise terms. Otherwise, the reader cannot be certain what you intend to do.
- **Poorly Defined Research Problem** -- the starting point of most new research is to formulate a problem statement and begin the process of formulating questions about that problem.
- **Lack of Theoretical Framework** -- the theoretical framework represents the conceptual foundation of your study. Therefore, your research design should include an explicit set of basic postulates or assumptions related to the research problem and an equally explicit set of logically derived hypotheses.

Research Methodology

- The methods section of a quantitative study should describe how each objective of your study will be achieved. Be sure to provide enough detail to enable that the reader can make an informed assessment of the method being used to obtain results associated with the research problem.
- Study population and sampling -- where did the data come from; how robust is it; note where gaps exist or what was excluded. Note the procedures used for their selection;
- Data collection – describe the tools and methods used to collect information and identify the variables being measured; Describe the methods used to obtain the data; Note if the data was pre-existing [i.e., government data] or you gathered it yourself. If you gathered it, describe what type of instrument you used and why. Note that no data set is perfect--describe any limitations in methodology.
- Data analysis -- describe the procedures for processing and analysing the data. If appropriate, describe the specific instruments of analysis used to study each research objective.

Research Methodology

- Research Questions (Problem Statement)
- Research Objectives
- Research Hypothesis
- Research Design
- Sampling Design: Sampling Technique, Sample Size
- Data Collection Strategies: Identifying and Defining Variables under Study, Data Sources (Secondary Sources), Data Collection Instrument (Primary Studies), Questionnaire Pretesting and Pilot Study, Duration of Study
- Tools and Techniques of Data Analysis- Relevant method

Research Methodology

Guidelines for effective Methodology (Materials and Methods) sections in scientific reports (Tischler)

Questions to address:	How to address them:
How did you study the problem?	Briefly explain the general type of scientific procedure you used.
What did you use? (May be listed as Materials)	Describe what materials, subjects, and equipment (chemicals, experimental animals, apparatus, etc.) you used. May be listed as animals, reagents, etc.
How did you proceed? (May be listed as Methods or Procedures)	Explain the steps you took in your experiment. (May be listed as experiment, types of assay, etc.)

Data Analysis

- Data Analysis: Description of how the Data is Analysed and precise presentation of how the results are arrived at.
- It covers the application of descriptive and inferential statistics, econometric tools , other tools used for analysing the data.

Results/Findings

- The results section of the research paper is where you report the findings of your study based upon the information gathered as a result of the methodology [or methodologies] you applied.
- The results section should simply state the findings, without bias or interpretation, and arranged in a logical sequence.
- The results section should always be written in the past tense.
- A section describing results [a.k.a., "findings"] is particularly necessary if your paper includes data generated from your own research.

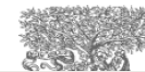
Results

Results – what have you found?

Driving force of the publication:
Tell a clear and easy-to-understand story

The following should be included:

- the **main findings**
 - Thus not *all* findings
 - Findings from experiments described in the Methods section
- Highlight findings that **differ** from findings in previous publications, and **unexpected** findings
- Results of the **statistical analysis**



Results

How to Present Your Results (Tischler)

In the Results section, you will be explaining what you observed:

Question to address:	How to address it:
What did you observe?	For each experiment or procedure: • Briefly describe the experiment (not in as much detail as the Methods section) • Report main result(s), supported by selected data: 1. Representative (most common) 2. Best case: best example of ideal or exception

Results

Additional tips:

1. **Order** multiple results logically:
from most to least important
from simple to complex
organ by organ; chemical class by chemical class.
2. **Use past tense** to describe *what happened*.
3. **What to avoid:**
Don't simply repeat table data; **select**.
Don't interpret results.
Avoid extra words:
Not: "It is show in Table 1 that X induced Y"
Better: "X induced Y (Table 1)."
4. Create tables with the Table pull-down in Word. Do not use tabs.

Discussion/Interpretations

Discussion

Discussion – what do the results mean?

- **Here you get the chance to SELL your data!**
 - Many manuscripts are rejected because the Discussion is weak
- **Check for the following:**
 - How do your results relate to the original question or objectives outlined in the Introduction section?
 - Do you provide interpretation for each of your results presented?
 - Are your results consistent with what other investigators have reported? Or are there any differences? Why?
 - Are there any limitations?
 - Does the discussion logically lead to your conclusion?
- **Do not:**
 - Make statements that go beyond what the results can support
 - Suddenly introduce new terms or ideas

Discussion

Questions to address:	How to address them:
What do your observations mean?	• Summarize the most important findings at the beginning.
What conclusions can you draw?	• Describe the patterns, principles, relationships results show. • Explain how your results relate to expectations and to literature cited in your Introduction. Do they agree, contradict, or are they exceptions to the rule? • Explain plausibly any agreements, contradictions, or exceptions. • Describe what additional research might resolve contradictions or explain exceptions.
How do your results fit into a broader context?	• Suggest the theoretical implications of your results. • Suggest practical applications of your results? • Extend your findings to other situations or other species. • Give the big picture: do your findings help us understand a broader topic?

Discussion

Additional tips:

1. **Move from specific to general:** Your findings(s) → literature, theory, practice.
2. **Don't ignore or bury the major issue.** Did the study achieve the goal (resolve the problem, answer the question, support the hypothesis) presented in the Introduction?
3. **Make explanations complete.**
Give evidence for each conclusion.
Discuss possible reasons for expected and unexpected findings.
4. **What to avoid:**
Don't over generalize.
Don't ignore deviations in your data.
Avoid speculation that cannot be tested in the foreseeable future.

Conclusions

Conclusions

- Do not summarize the paper
 - The abstract is for that purpose
- Present what have you shown and what it means for the field
- Suggest future experiments and indicate whether they are underway
- Avoid bold judgments about impact

Conclusions

Conclusions

- Provide a *very brief* summary of the Results and Discussion.
- Emphasize the implications of the findings, explaining how the work is significant and providing the key message(s) the author wishes to convey.
- Provide the most general claims that can be supported by the evidence.
- Provide a future perspective on the work.
- *Avoid:* repeating the abstract; repeating background information from the Introduction; introducing new evidence or new arguments not found in the Results and Discussion; repeating the arguments made in the Results and Discussion; failing to address all of the research questions set out in the Introduction.

Conclusions

- The conclusion is intended to help the reader understand why your research should matter to them after they have finished reading the paper.
- A conclusion is not merely a summary of your points or a re-statement of your research problem but a synthesis of key points.
- For most essays, one well-developed paragraph is sufficient for a conclusion, although in some cases, a two-or-three paragraph conclusion may be required.
- **Importance of a Good Conclusion**
- A well-written conclusion provides you with several important opportunities to demonstrate your overall understanding of the research problem to the reader. These include:

REFERENCES/CITATIONS

REFERENCES/CITATIONS

- Because virtually all scientific advances build on past knowledge, it is critical that the new work be placed in the proper context with respect to the past work upon which it builds. The primary mechanism for this is the citation (or reference).
- Within a scientific paper, references are placed to other works, creating points of contact with the communal collection of scientific literature in order to fit the new work into the web of knowledge.
- But given the skeptical attitude that is also a part of science, citations are also used to help readers verify the quality of the new work and assess the strength of its conclusions.

REFERENCES/CITATIONS

References: get them right!

- **Cite the main scientific publications on which your work is based**
- **Check**
 - Referencing style of the journal (Guide for Authors)
 - The spelling of author names, the year of publication
 - Punctuation use

REFERENCES/CITATIONS

Preparing the Reference Section

Your reference list should appear at the end of your paper. It provides the information necessary for a reader to locate and retrieve any source you cite in the body of the paper. Each source you cite in the paper must appear in your reference list; likewise, each entry in the reference list must be cited in your text.

Your references should begin on a new page separate from the text of the essay; label this page "References" centered at the top of the page (do NOT bold, underline, or use quotation marks for the title). All text should be double-spaced just like the rest of your essay.

Referencing Formats/Citation Styles

- Researchers and writers should understand some of the following styles:
- **APA** The American Psychology Association – Use this style for education, psychology, sociology and other social sciences.
- **Example of APA style for a book with one author:** Doe, J. (1999). *Causes of the Civil War*. Ohio: Smith Books.
- **Resources:**
- [Publication Manual of the American Psychological Association](#)
- [APA Formatting and Style Guide](#): Available online from The Owl at Purdue, this contains examples of reference list entries and in-text citations.
- [Basics of APA Style Tutorial](#): Available online from the APA, this outlines citing and writing guidelines.
- Read more: <https://html.com/resources/citation-guide/#ixzz6Ntml5059>

Referencing Formats/Citation Styles

- **MLA**

Modern Language Association – Use this style for arts, literature and the humanities.

- **Example of MLA style for a book with one author:** Doe, John: "Causes of the Civil War." Smith.

Resources:

- [MLA 2009 Formatting and Style Guide](#): Available online from The Owl at Purdue, with many examples for producing works cited entries and in-text footnotes.

- [MLA Style Manual and Guide to Scholarly Publishing](#): Available online from The Owl at Purdue, contains examples.

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Read more: <https://html.com/resources/citation-guide/#ixzz6NtmyFKyQ>

Referencing Formats/Citation Styles

- **AMA or NLM:** American Medical Association or the National Library of Medicine for health, medicine and biological sciences.
- **Example of AMA for a book with one author:** Doe JD. *Causes of the Civil War*. Columbus, OH: Smith Books; 1999.
- **Example of NLM for a book with one author:** Doe, JD. Causes of the Civil War. Columbus (OH): Smith Books; 1999.
- **Resources:**
- [AMA Manual of Style: A Guide for Authors and Editors](#)
- [Citing Medicine: The NLM Style Guide for authors, editors and publishers](#); available online from the National Library of Medicine.
- Read more: <https://html.com/resources/citation-guide/#ixzz6Ntn85imk>

Programs for Creating Citations

- The following resources provide programs to help researchers create citations:
- [Landmark Citation Machine](#)
- [KnightCite](#)
- [Citation Builder](#)
- [EasyBib](#)



Writing Approaches

Preparing to Write

- Carefully analyze the assignment to determine what you are specifically being asked to do. The way in which your professor may ask you to frame your analysis can include any of the following approaches:
- **Comparison approach** in which the task is to compare and contrast two ideas, constructs, or tangible things with one another.
- **Definition approach** that asks you to discuss in depth the cultural and associative meanings of, for example, a political theory, a policy proposal, or a controversial practice.

Preparing to Write

- **Descriptive approach** where you choose a subject that you know well and help others to understand it.
- **Evaluative approach** that asks you to assess a theoretical concept, issue, person, place, or thing in a critical, but not necessarily critical, way.
- **Exploratory approach** in which you are asked to pursue a specific line of inquiry, often with the purpose of making recommendations for further research or to advocate for specific actions to be taken.
- **Interpretive approach** that requires you to apply the theoretical knowledge gained in a course to a particular case study, such as, a business situation in a management course or a psychological case profile.

Preparing to Write

- **Narrative approach** written from a certain point of view, usually your own and written in the first person.
- **Persuasive approach** in which you are asked to take a position in a scholarly argument and give the reader reasons why they should agree with your position.
- **Policy memorandum approach** in which you are asked to write short factual sentences devoid of emotion that summarize a situation to date, identify the main issue of concern, provide a breakdown of the elements of this main issue, and then recommend how to address the issue based on research about the topic.

Structure of A Research Paper

Scientific Approach: Structure of a Research Paper

- Key to writing and effectively organizing or formatting the scientific research paper is to understand the structure (different sections or parts) that are typically included in a scientific research paper

IMRAD Approach

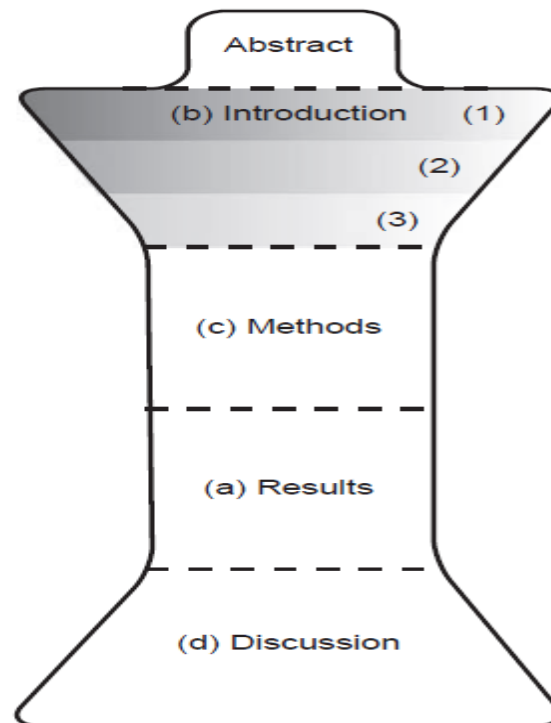
- Rebecca Bartow, Ph.D., an instructor at Western Kentucky University helps to simplify the organization of a scientific paper by using the IMRAD Approach:
- **I** - Introduction: What problem (question) was studied?
- **M** – Methods: How was the problem studied?
- **R** – Results: What were the findings?
- **A** – and
- **D** – Discussion: What do these findings mean?

AIMRaD Approach

M. Cargill and P. O'Connor have extended this approach to:

- A-Abstract,
- I-Introduction,
- M-Materials and methods,
- R-Results
- a-and
- D-Discussion
- and its variations

AIMRaD Approach



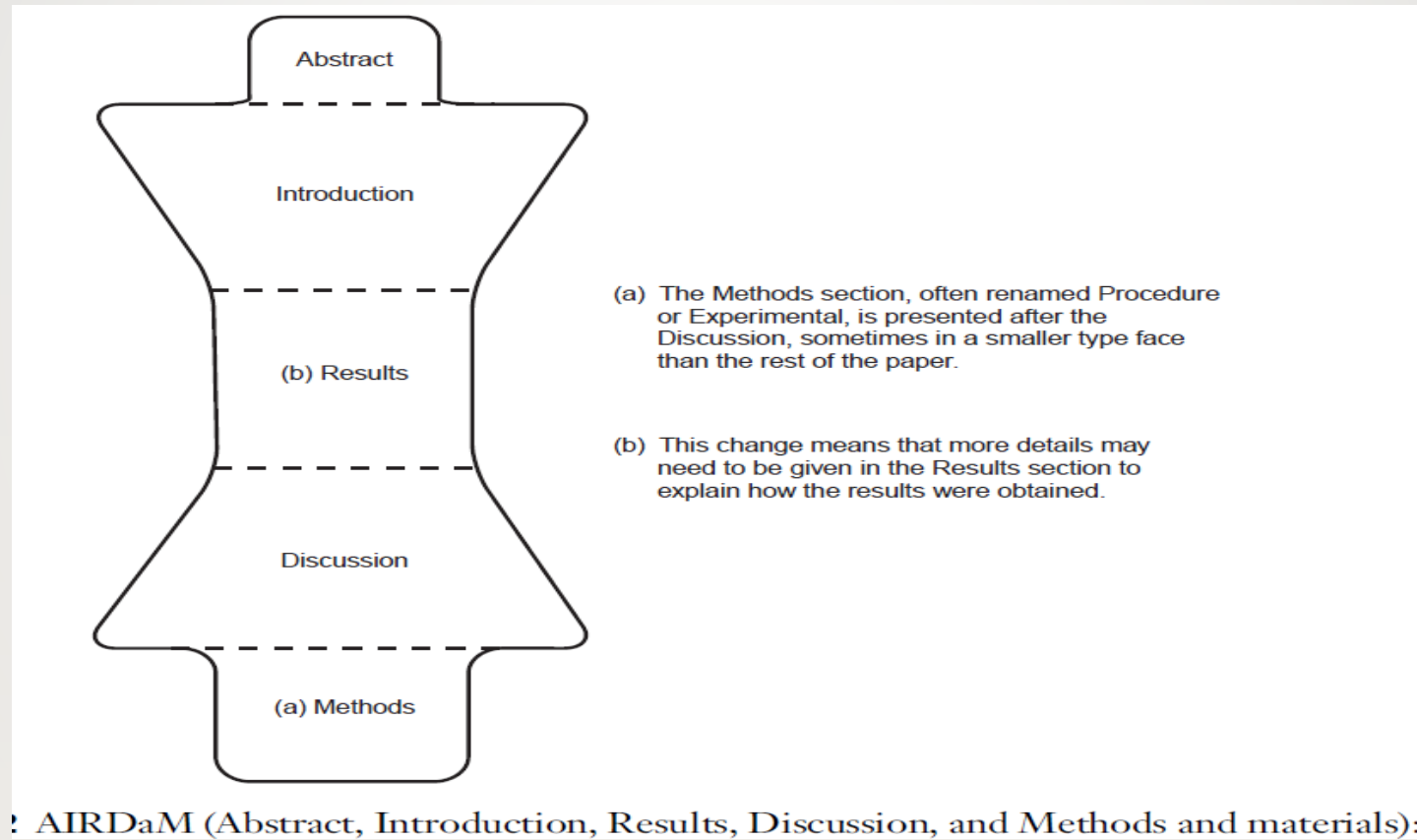
- (a) The whole structure is governed by the Results box; everything in the article must relate to and be connected with the data and analysis presented in the Results section.
- (b) (1) The Introduction begins with a broad focus. The starting point you select for your Introduction should be one that attracts the lively interest of the audience you are aiming to address: the international readers of your target journal.
- (3) The Introduction ends with a focus exactly parallel to that of the Results; often this is a statement of the aim or purpose of the work presented in the paper, or its principal findings or activity.
- (2) Between these two points, background information and previous work are woven together to logically connect the relevant problem with the approach taken in the work to be presented to address the problem.
- (c) The Methods section, or its equivalent, establishes credibility for the Results by showing how they were obtained.
- (d) The Discussion begins with the same breadth of focus as the Results – but it ends at the same breadth as the starting point of the Introduction. By the end, the paper is addressing the broader issues that you raised at the start, to show how your work is important in the ‘bigger picture.’

2.1 AIMRaD: the hourglass “shape” of a generic scientific research article

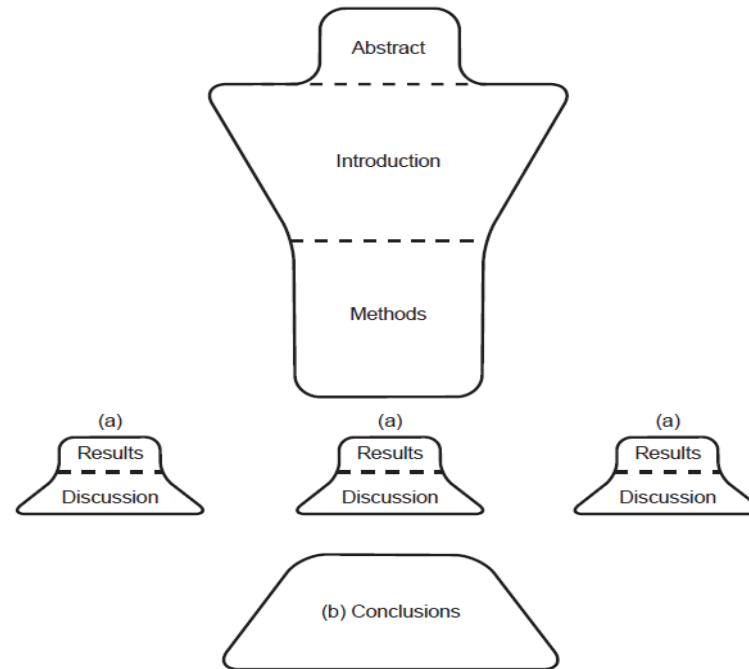
AIMRaD Approach

- In this diagram, it is the width and shape of the segments, rather than their depth, that tell us something important about scientific articles.
- There are different variants of this basic model adopted by journals of different disciplines as under, depending upon which section of this model they want to emphasize:

AIRDM Approach



AIMRDC Approach



(a) The Results and Discussion are presented together in a single combined section; each result is presented, followed immediately by the relevant discussion.

(b) This change means that a separate section is needed at the end to bring the different pieces of discussion together; it is often headed Conclusions.

General Scientific Structure for Social Sciences and Humanities: TAKILMRDC Approach

- T-Title
- A-Abstract
- K-Keywords
- I-Introduction
- L-Literature Review
- M-Methodology
- R-Results
- D-Discussions
- C-Conclusion

General Scientific Structure

- **The Big Picture: Sections of a Scientific Research Paper includes:**
- **Abstract** – States the principal objectives and scope of the investigation, describes the methods used, summarizes the results, and states the principal conclusions in less than 250 words (maximum).
- **Introduction** – Clearly states the purpose of the paper with a hypothesis, thesis or topic sentence.
- **Review of Literature** – Provides an extensive search of the literature to discover what is known about the subject to date. This also includes how the search of the literature was conducted.
- **Methodology or Materials and Methods** – The section where key terms are described. Also included are the research instruments and procedures used in conducting the study, or researching the topic.
- **Results** – This is where the findings are reported. This section may include tables and figures that summarize the data or information.
- **Discussion** – This is the main body of the paper, the section for reporting findings, sharing thoughts and analysis of the results.

General Scientific Structure

- **Conclusions** – The conclusions presented in the paper are those supported by the data. They also reflect the original purpose for the paper from the introduction. Researchers often answer a few questions, but raise several more to pursue in future research projects.
- **References** – References should include an extensive list of relevant studies discovered reviewing the literature. Ideally important older studies are included along with current, newer ones.
- **Abbreviations** – A list of all abbreviations (shortened form of a word or phrase used for brevity in place of the whole) used in the manuscript or paper.
- **Tables** – A set of data organized and arranged in rows and columns.
- **Figures** – A diagram, picture or photograph illustrating material from the text or research data.
- **Appendix** – Supplementary material appended or added at the end of the paper such as research data, handouts. These may include tables, figures and multimedia sources.

Thank You