

Introduction, Literature Review, and Conclusion

The Introduction to a thesis must contain

- A. The Importance of the field of work (the topic),
- B. A literature review
- C. The research gap
- D. Research problem
- E. Research objectives and scope
- F. Specific research questions
- G. Methodology applied
- H. Contribution of the thesis
- I. An overview of the thesis
- J. Chapter-wise summary

The Introduction to a thesis must contain

- | | |
|---|-------------------------|
| A. The Importance of the field of work (the topic), | Yes |
| B. A literature review | Short Literature Review |
| C. The research gap | Yes |
| D. Research problem | Yes |
| E. Research objectives and scope | Yes |
| F. Specific research questions | Yes |
| G. Methodology applied | Yes |
| H. Contribution of the thesis | Yes |
| I. An overview of the thesis | Yes |
| J. Chapter-wise summary | Yes |

Are there any guidelines for choosing the research topic?

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Yes, the student's background and the supervisor's expertise influence the choice.

Student's Strength	Supervisor's Expertise		
		Domain	Research Tools
	Domain	<i>Application-strong</i>	<i>Desired Mix</i>
	Research Tools	<i>Desired Mix</i>	<i>Theory-strong</i>

What is the nature of the literature review which is presented in the Introduction?

What is the nature of the literature review which is presented in the Introduction?

It is short.

It considers only the most relevant past works.

It establishes a stable common ground (popularly held view)

It indicates an incomplete or flawed research—research gap.

Name a few words/terms that are normally used to indicate a research gap.

Name a few words/terms that are normally used to indicate a research gap.

A sample of such words/terms are the following:

however, despite, rarely, not well understood, remains a major challenge, few studies, unclear, needs further investigation, although

What do you mean by a research problem?

What factors influence the choice of a research problem?

What do you mean by a research problem?

It is the discrepancy between the desired state and the actual state of a system.

What factors influence the choice of a research problem?

- Importance
 - Practical relevance (performance deterioration, financial loss, frequency, symptoms widespread, symptom ambiguity)
 - Unsolved problem
 - Theoretical challenge
- Past works
 - Recent interest
 - Multiplicity of issues
 - Volume of reported research work
 - Differing research results and interpretations
- New way of Investigation
 - Analysis (Influencing factors, Relationships, investigation Characterization, etc.)
 - Design (Optimal parameter values, New designs, etc.)

How can one specify a research problem? Give a few examples.

Does one have to always state the research problem?

How can one specify a research problem? Give a few examples.

The market share of a company is much below (5 %) compared to what the company desires (10%)

The labour productivity of the plant is 5000 units/person-month whereas the company desires a labour productivity of 10,000 units/person-month.

The number of defects detected over the last year has exhibited a rising trend (growing at an average rate of 5 defects/FP).

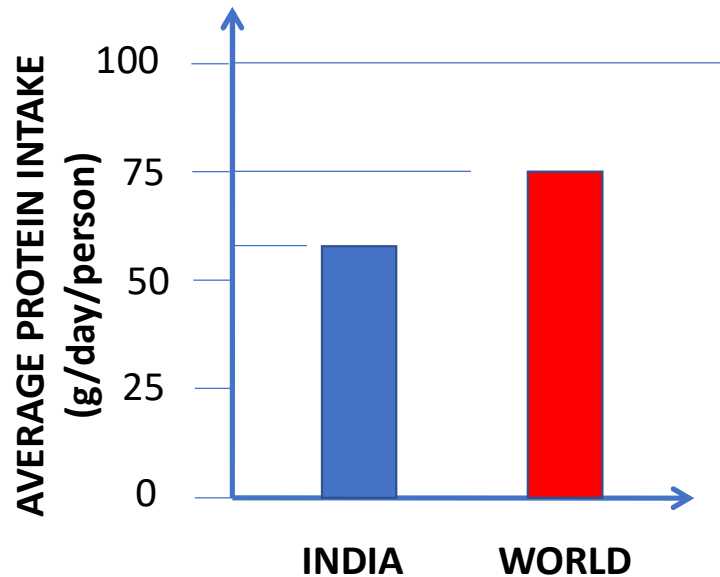
Does one have to always state the research problem?

No. One can state the research objectives and research questions, instead.

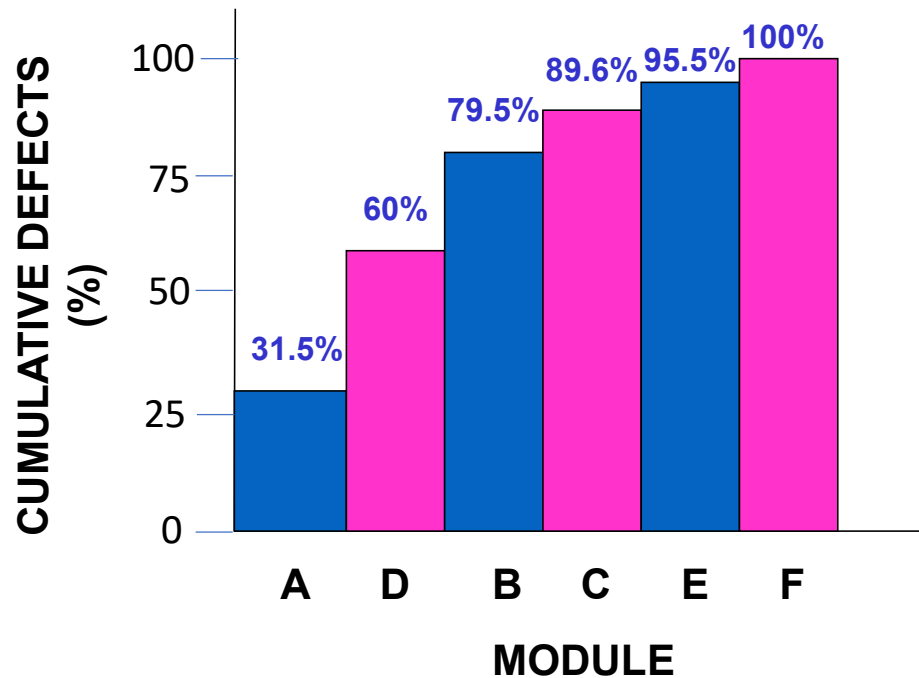
Should a research problem be graphically portrayed? If yes, give examples.

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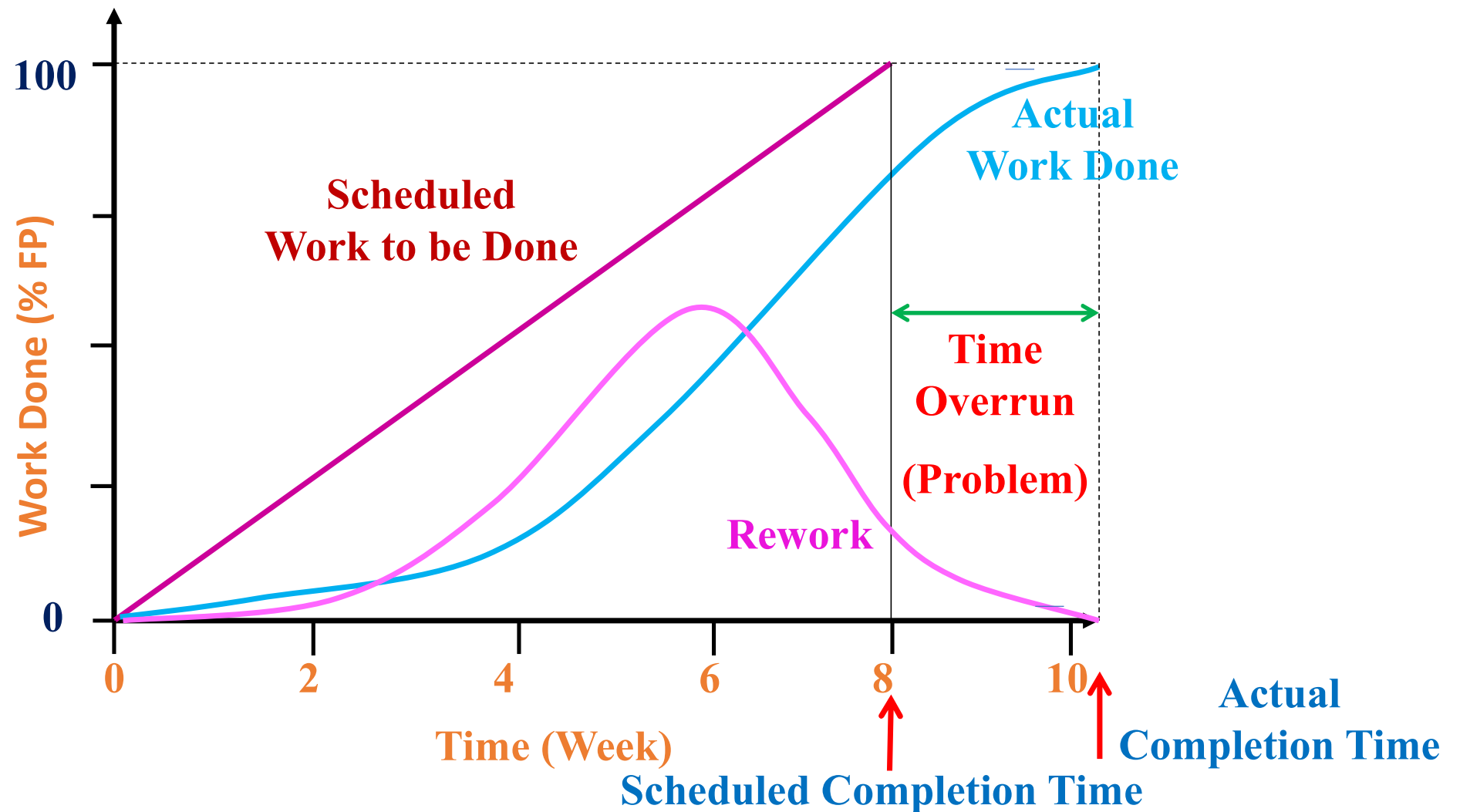
Yes. Examples are given below and in the next slide.



LOW PROTEIN INTAKE IN INDIA



SOFTWARE DEFECTS



Schedule Overrun in Software Projects

How to project the importance of a research problem?

How to project the importance of a research problem?

By estimating its positives and negatives

Positives

Fill the knowledge gap

Further research in the same field

Apply to various fields of research and application

Negatives

The opportunity cost

The disbenefits

What is a research objective?

What are the characteristics of research objectives?

What is a research objective?

The research objective is a statement of the goal towards which research is directed.

What are the characteristics of research objectives?

1. They are usually qualitatively stated.
2. They usually start with “to/To.”
3. They may be more than one in number.

What could be the different forms of research objectives?

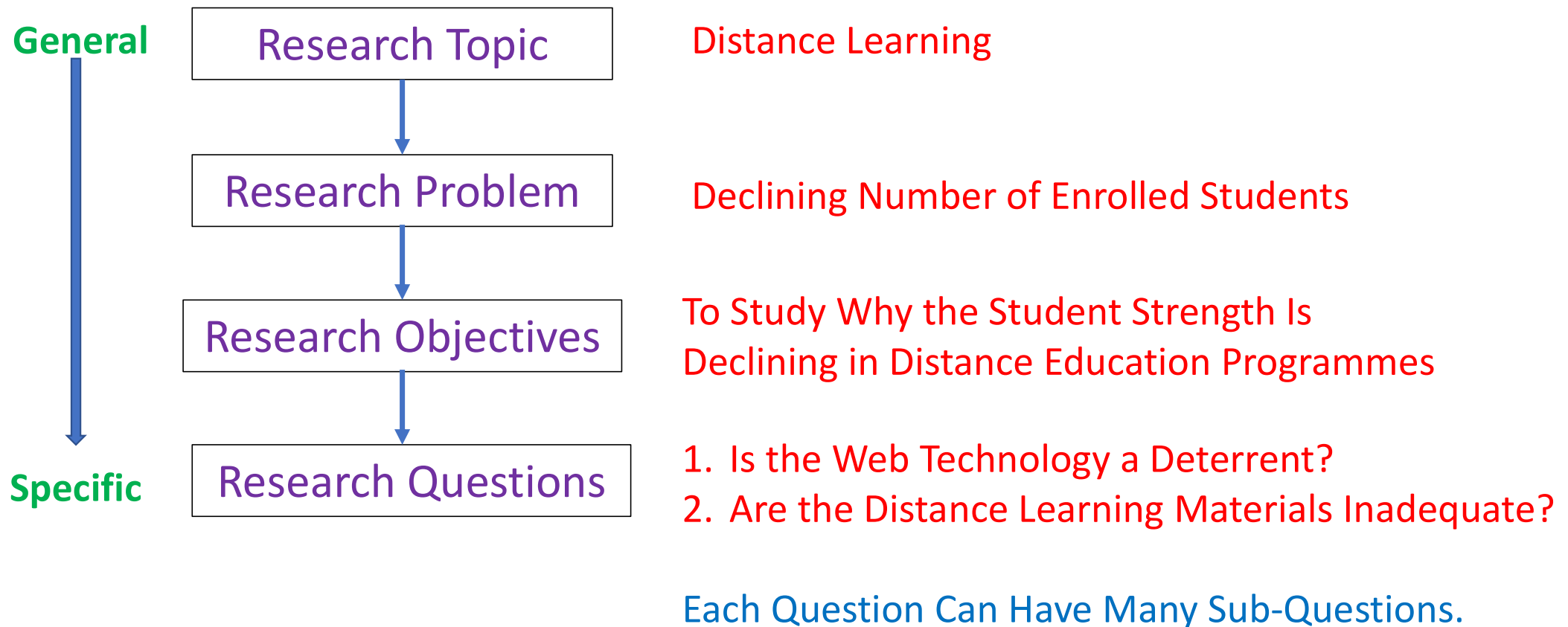
What could be the different forms of research objectives?

- To understand/explain a phenomenon
- To predict a future event
- To improve performance
- To make a new interpretation of data, text, and concepts
- To discover new entities and find their characteristics
- To design artifacts and find their use values
- To make optimal design, operational, or maintenance decisions
- To estimate parameter values
- To solve an unsolved mathematical problem

Give examples of research objectives.

Give examples of research objectives.

- **Research Topic:** Commodity Price
- **Research Problem:** Rising potato price
- **Research Objectives:**
 - To extract the factors that significantly influence the potato price.
 - To quantitatively estimate the effect of each of the extracted significant factors on potato price.
 - To recommend a set of policies that help stabilizing potato price.



Are research questions necessary?

What are their features?

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Yes.

What are their features?

- | | |
|-------------------------|---|
| Should be evocative: | A contemporary issue, A paradox, A new approach |
| Should be relevant: | Represents the research gap and connected to the objective |
| Should be clear: | A small number of high-level variables and be practicable |
| Should be researchable: | Resources availability, time, ethical background, and other constraints |

Give some examples of research questions.

Give some examples of research questions.

- What leads to the observed problem?
- Which factors are the most influential?
- What are the relationships among the factors?
- What are the optimal factor settings?
- How will the system behave in a different circumstance?
- What is the likely future system behaviour?
- How to improve the system performance?
- What performance improvement is possible?
- Which design is the best?

What do you mean by scoping a problem?

Give some examples.

What do you mean by scoping a problem?

Specifying the factors that the researcher thinks as significantly influencing the problem.

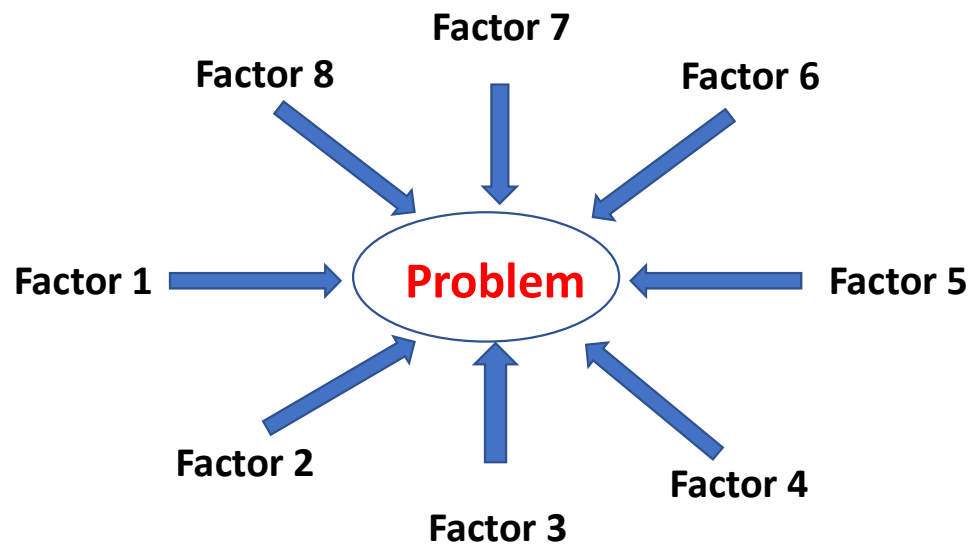
Give some examples.

The thesis considers the rising potato prices that occurred in Odisha. It is a *spatial condition*.

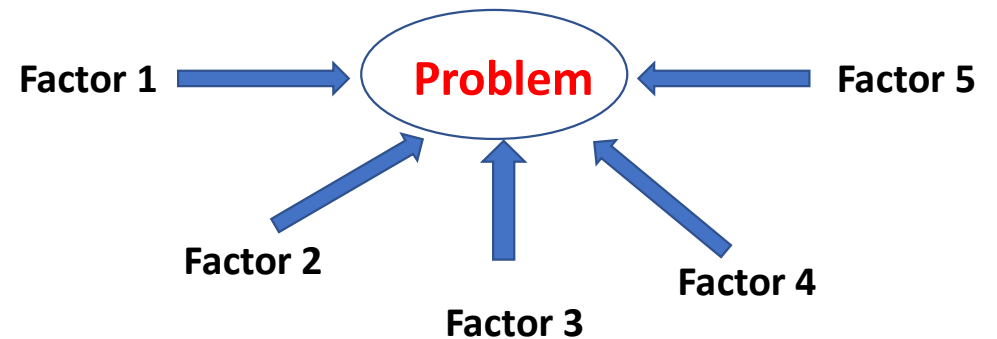
The potato prices during May–August 2010 are considered. It is a *temporal condition*.

Demand of potato is assumed time-invariant. It is a *methodological assumption*.

What do you mean by scoping a problem?



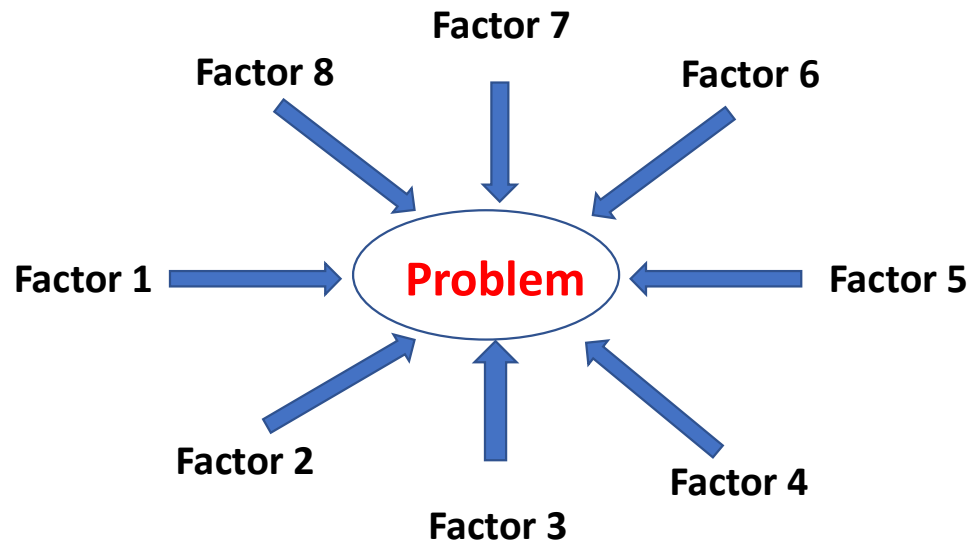
Real System Boundary



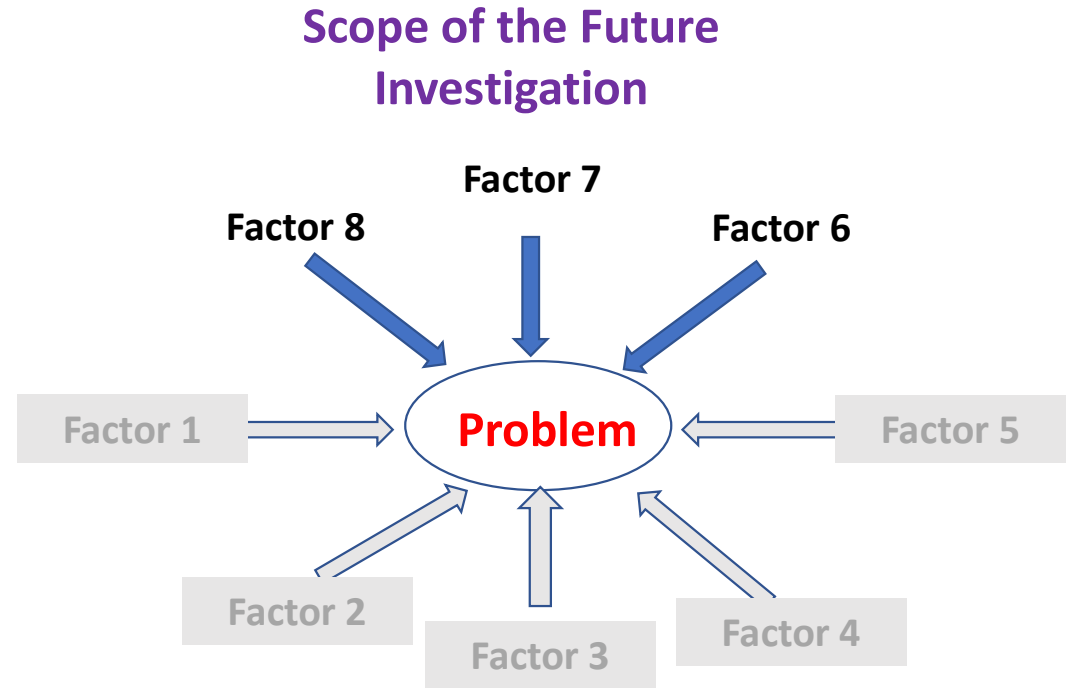
Study Boundary

Space, Time Horizon, Subjects, Material, Equipment, Market, Parameter Characteristics, etc., for which the study is carried out, are to be specified.

Future Scope



Real System Boundary



An epigraph is a short, well-known quotation relevant to the contents of the text. What are the rules to follow to insert an epigraph in the thesis?

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An epigraph should

Be a short, well-known, and relevant quotation.

It should appear at the top of the first page of the Introduction.

It should be right-justified.

It should be italicized.

Its font size should be larger than that of the main text.

It should not have any quotation marks.

The names of the authors should be upright, in small font, and right-justified.

The strategy to follow to make the Introduction to a paper interesting can be one or more of the following (Select the correct ones):

- A. Give a statistic
- B. Quote an expert
- C. Mention a commonly held misconception that the thesis argues against
- D. Give commonly accepted definitions of terms
- E. Mention the novelty of the work
- F. Follow up general information by specific information.
- G. Old information be followed by new information

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- F. Follow up general information by specific information. Yes
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Do you think the Introduction to a paper with the following features is problematic?

- A. The first paragraph of a paper runs into two pages.
- B. The objective is specified on page 22 of the thesis.
- C. The Introduction does not mention the contribution of the work.
- D. The contribution mentioned is actually a summary of the work done.
- E. Introduction indicates neither the methodology used nor the results obtained.

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| B. The objective is specified on page 22 of the thesis. | Yes |
| C. The Introduction does not mention the contribution of the work. | Yes |
| D. The contribution mentioned is actually a summary of the work done. | Yes |
| E. Introduction indicates neither the methodology used nor the results obtained. | Yes |
| F. Introduction runs for only two pages. | No |
| G. Introduction specifies 10 objectives | yes |

Are the following justified?

- A. Contribution of a Ph.D. thesis mentions the summary of work done.
- B. Contribution of a Ph. D. thesis is not mentioned in the Introduction.
- C. Contribution does not specifically mention the novelty of the work.
- D. Contribution is written in five paragraphs that run into three pages.

Are the following justified?

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|--|----|
| A. Contribution of a Ph.D. thesis mentions the summary of work done. | No |
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| D. Contribution is written in five paragraphs that run into three pages. | No |

What should the contribution of a Ph. D. Thesis contain?

What should the contribution of a Ph. D. Thesis contain?

The contribution of a Ph. D. thesis should be the novelty of the work and can be one or more of the following:

1. A new problem
2. An old problem in a new setting
3. Old data explained and interpreted differently
4. New data generated with a new conclusion and interpretation
5. An old method that is modified appreciably
6. A new method
7. Surprising results that contradict held views

Do you have any suggestions for the first paragraph?

Do you have any suggestions for the first paragraph?

Yes, many. Some of these are the following:

It should highlight the research problem and its importance and consequences.

The last sentence should say the solution that the thesis has offered and the contribution that the thesis has made.

It should be about half a page.

It need not carry a section number.

A Ph.D. student has written the following first paragraph in the Introduction chapter of her thesis. Do you think the paragraph could be written in a different form?

It is well known that the world has started facing an acute drinking water crisis. India is no exception. The groundwater table has receded to about half its height over a period of 200 years. This thesis makes an attempt to develop a new method of rainwater harvesting suitable to the Indian condition.

A Ph.D. student has written the following first paragraph in the Introduction chapter of her thesis. Do you think the paragraph could be written in a different form?

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Supporting sources should be referenced for the first two claims, particularly for the claim made in the second sentence.

The *newness* of the method of rainwater harvesting could have been elaborated.

The third sentence highlighting the contribution of the thesis is a good attempt.

Literature Review

Do you consider the following as good practices for a literature review?

- A. The literature review gives only a summary of each work.
- B. The review of published papers is done chronologically.
- C. Each published paper is summarized in a separate paragraph.
- D. Each paragraph, devoted to the review of a paper, starts with the authors' names.
- E. The literature review is done separately for separate themes.
- F. The literature review is done highlighting the trend of development of methods.
- G. The literature review discusses the limitations of past works.
- H. The literature review traces the development of new methods.

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What does one mean by scoping a review?

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It means

- Selecting the papers to include and exclude.
- Not including everything.
- Including papers with direct relevance to the research problem for an old area .
- Including enough information and developing and establishing a logical framework for a new area.

Name the popular forms of literature review and state their features.

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A. Narrative Reviews

- Critical Review
- Conceptual Review
- State-of-the-Art Review

B. Systematic (Literature) Review (SLR)

C. Meta-Analysis (Quantitative)

D. Meta-Analysis (Qualitative)

E. Cochrane Review

F. Scoping Review

Narrative Reviews (Other names: Bibliographic Reviews, Standard Review, Comprehensive Review, Snow-Ball Review)

- Unstructured
- Lacks a priori review protocols
- Focuses on theory or methods on a specific topic
- Helps find the research gap
- Cannot be replicated
- Researcher's bias and assumptions influence the review

Critical Review:

- Limited to recent publications
- Develops perspectives on a research topic

Conceptual Review:

- Done in Editorials and Conceptual Papers
- Evaluates general consensus and the way it was reached

State-of-the-Art Review: Recent literature, Discusses agreements and disagreements.

How does one organize a narrative literature review?

How does one organize a narrative literature review?

Chronologically: Emergence of concepts with the progress of time

Thematically: Listing concepts, grouping them for themes, and mapping them to sources

Theoretically: Verification and falsification of old theories and the emergence of new theories

Methodologically: Methods used for data collection, data analysis, and theory formulation; Evolution of methods; Underlying assumptions

Systematic Literature Review (SLR)

- Is reproducible
- Searching and selecting literature based on inclusion and exclusion criteria
- Defines objective and protocol
- Tests for the presence of bias
- Assesses and synthesizes validity, flaws, and findings
- Follows PRISMA guidelines

Cochran Review

- A subset of SLR
- Studies of interventions
- Examines conclusive evidence
- Follows Cochran Manual

Scoping Review

- Like an SLR
- Assesses detailed information
- Clarifies concepts, definitions, features and factors
- Used as a pre-assessment for SLR
- Follows PRISMA guidelines

Meta-Analysis (Quantitative and Qualitative)

- All the features of SLR
- Homogeneity test
- Quantitative or qualitative assessment
- Follows PRISMA guidelines

Give examples of inclusion and exclusion criteria in an SLR.

Inclusion Criteria Examples

Exclusion Criteria Examples

Give examples of inclusion and exclusion criteria in an SLR.

Inclusion Criteria Examples

- Written in English
- Research questions matching those of the current research

Exclusion Criteria Examples

- Methods described inadequately
- Supporting data not reported

What do you mean by publication bias and heterogeneity that are considered in meta-analysis?

Publication Bias

Heterogeneity

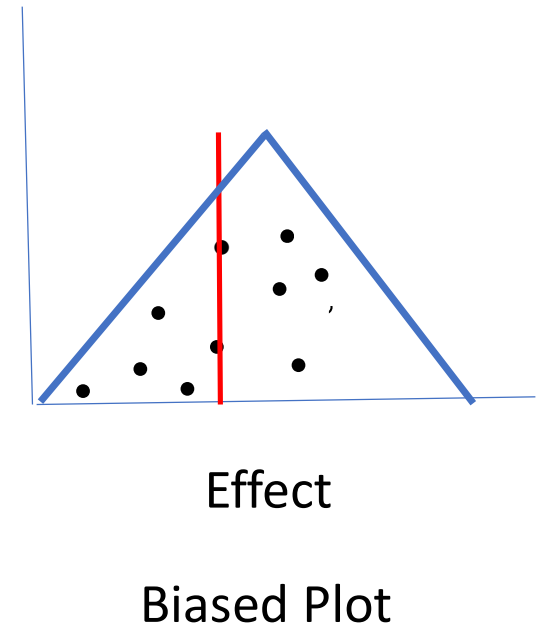
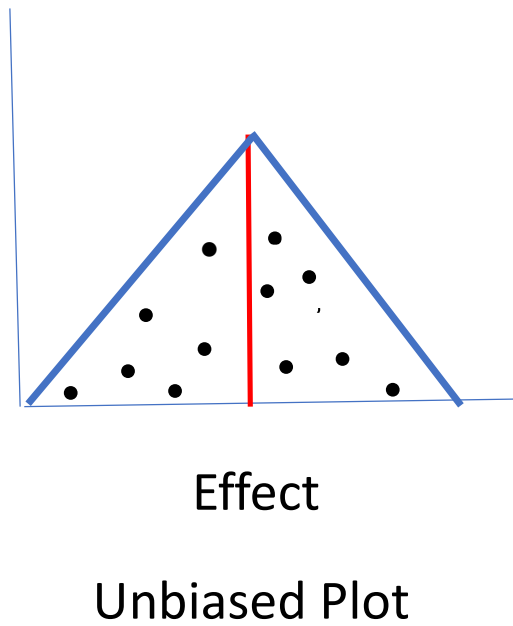
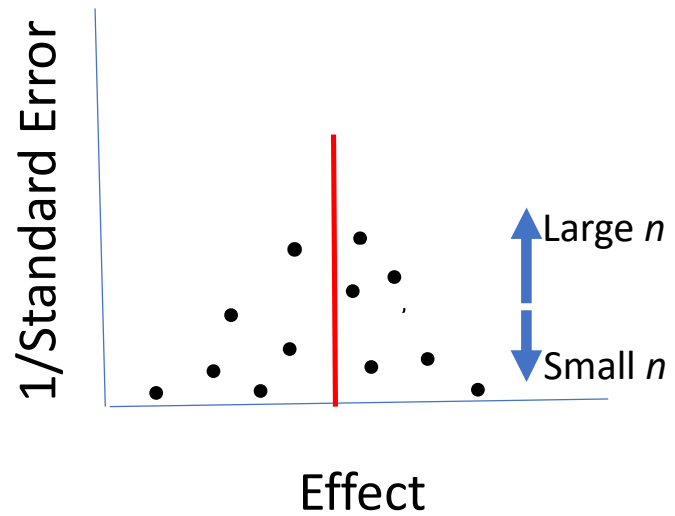
What do you mean by publication bias and heterogeneity that are considered in meta-analysis?

Publication Bias

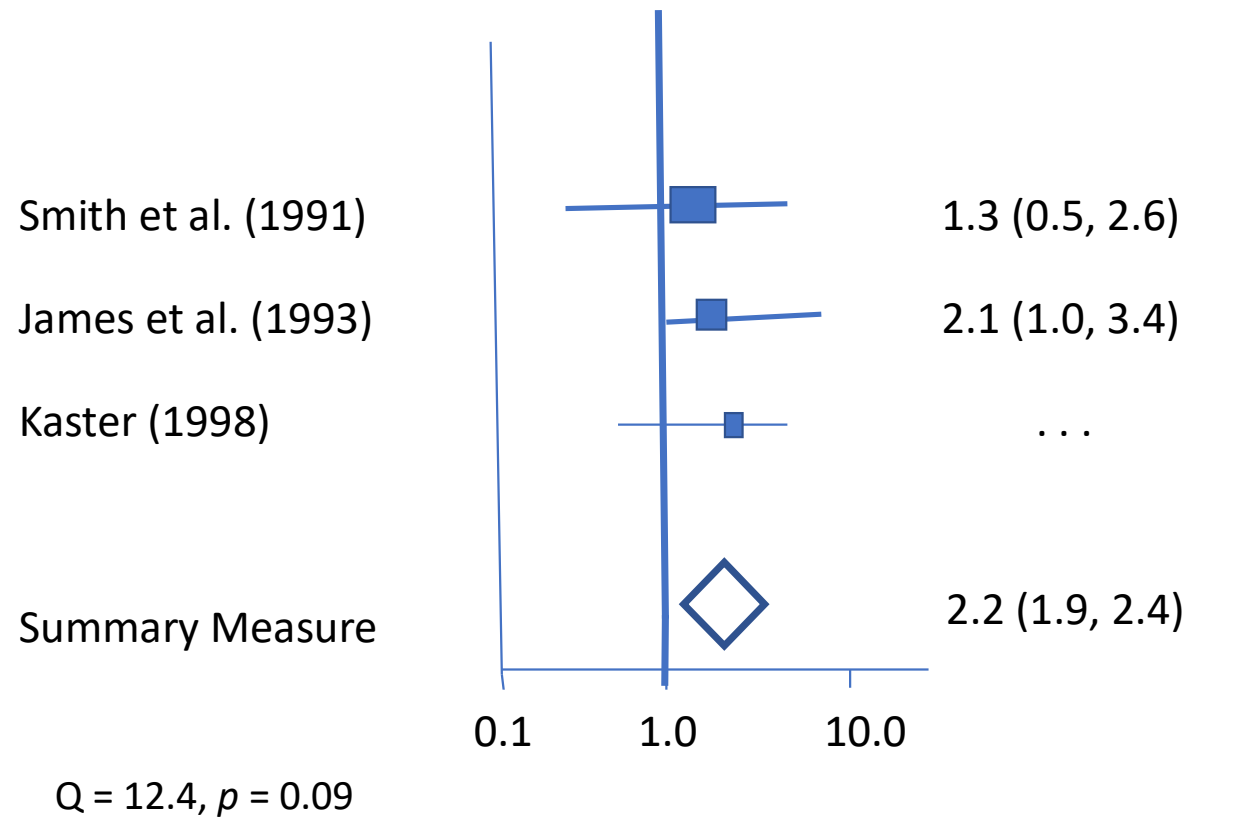
- Many researchers do not report their research results when these are insignificant, while those with significant results tend to get published.
- For homogeneous research results precision plotted against effect (a measure common to all studies) would be distributed symmetrically (funnel plot) for large and small sample sizes.

Heterogeneity

- Research results are homogeneous if box plots of effects (forest plot), representing the variability of results overlap each other.



Forest Plot (or Blobbogram)



Give an example of statistical meta-analysis.

Effect of Exercise on Self-Esteem

Study	Control Group		Experimental Group		Pooled std. dvn.	t
	n_{control}	xbar	n_{expt}	xbar		
A	41	11	41	17	10	2.72**
B	29	225	33	175	100	-1.95
C	104	9	98	12	7	2.03*
D	11	23	11	31	12	1.56

* $p < .05$, two-tailed test, ** $p < .01$ two-tailed test

Traditional Review Conclusion:

Significantly greater self-esteem in A and C, but not in studies B and D.

The results are thus disparate.

$$t_o = \frac{\bar{x}_2 - \bar{x}_1}{S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \sim \chi^2_{n_1+n_2-2}$$

Study	t	df	One-tailed p	z	$-2 \log_e p$
A	2.72	80	.004	2.65	11.04
B	-1.95	60	.970	-1.88	0.06
C	2.03	200	.024	1.98	7.46
D	1.56	20	.060	1.52	5.63

Fisher: $-2 \sum_{i=1}^K \log_e p = 24.19, df = 8$. The associated $p < .01$

Winer: $\frac{\sum t}{\sum \frac{df}{df-2}} = 2.1$. The associated $p < .018$

Stouffer: $\frac{\sum z}{\sqrt{K}} = 2.13$. The associated $p < .017$

H_1 is accepted. That is, Exercise Does Enhance Self-Esteem.

What are summaries, paraphrases, and quotations? How to use them in a literature review?

What are summaries, paraphrases, and quotations? How to use them in a literature review?

Summary: A summary is a significantly condensed narration of the main points of a text, written in the reviewer's own words. A summary must be attributed to the source.

Paraphrase: A paraphrase is a narration of the main points of a passage, written in the reviewer's own words. A paraphrase must be attributed to the source.

Quotation: A quotation is a reproduction of a word, phrase, or passage from a source text, with proper attribution to the source and its location on pages.

Why are summaries, paraphrases, and quotations used?

Why are summaries, paraphrases, and quotations used?

- To make the researcher's claim credible.
- To use and build on someone else's definitions, methods, and results.
- To agree or disagree with a specific viewpoint.
- To make the researcher's work broad and deep.

Write the following sentences with the accepted forms of in-text citation:

- A. Sapru's (2004) book on public policy is the first of its kind in India.
- B. The paper on Special Theory of Relativity by Einstein brought about a revolution (1905).
- C. The page 25 of a book on Deterministic Chaos published by the Universities Press in the year 1996 by N. Kumar explains the phenomenon of chaos and gives its definition.

Write the following sentences with the accepted forms of in-text citation.

A. Sapru's (2004) book on public policy is the first of its kind in India.

The book on public policy by Sapru (2004) is the first Indian book on the subject.

A. The paper on Special Theory of Relativity by Einstein brought about a revolution (1905).

The paper on Special Theory of Relativity by Einstein (1905) brought about a revolution.

A. The page 25 of a book on Deterministic Chaos published by the Universities Press in the year 1996 by N. Kumar explains the phenomenon of chaos and gives its definition.

Kumar has explained the phenomenon of Deterministic Chaos and gives its definition (Kumar 1996, p. 25).

Gouri Gopalan wrote in her book on page 25: A *system* is a collection of “interacting parts.”

A research student wishes to write an in-text quotation of Gopalan’s definition of *system*. She started by writing the following:

Defining the word system, Gopalan (2015) mentions that . . .

Write the remaining quotation.

Gouri Gopalan wrote in her book on page 25: A *system* is a collection of “interacting parts.”

A research student wishes to write an in-text quotation of Gopalan’s definition of the word *system*. She started by writing the following:

Defining the word system, Gopalan (2015) mentions that “[a] *system* [italic original] is a collection of ‘interacting parts.’”

A PhD student wishes to quote the following passage from page 243 of the book entitled, *The Emperor of All Maladies: A Biography of Cancer*, authored by Siddhartha Mukherjee that was published in the year 2010 by Scribner, New York.

The conference was a lunatic comedy. One expert, having noted parenthetically that large urban town (where cigarette consumption was the highest) had much higher rates of lung cancer than villages (where consumption was the lowest), concluded that “the only adequate explanation” was the “smokinesss of pollution of the atmosphere.” Others blamed influenza, the fog, lack of sunshine, X-rays, road tar, the common cold, coal fires, industrial pollution, gasworks, automobile exhaust—in short, every breathable form of toxin except cigarette smoke.

Start your sentence as the following: In his famous book on Cancer, Mukherjee . .

Highlight the word “cigarette smoke” by writing it in *italic*. Omit the words “having noted parenthetically that large urban town (where cigarette consumption was the highest) had much higher rates of lung cancer than villages (where consumption was the lowest).”

In his famous book on Cancer, Mukherjee mentions the following:

The conference was a lunatic comedy. One expert . . . concluded that “the only adequate explanation” was the “smokiness of pollution of the atmosphere.” Others blamed influenza, the fog, lack of sunshine, X-rays, road tar, the common cold, coal fires, industrial pollution, gasworks, automobile exhaust—in short, every breathable form of toxin except *cigarette smoke* [italic added]. Mukherjee 2010, p. 243.

Mukherjee, S. (2010), *The Emperor of All Maladies: A Biography of Cancer*, New York: Scribner.

Which referencing styles are dominantly used?

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1. Author-Number (Vancouver)
2. Author-Date (Harvard) with variations like APA and MLA
3. Numerical (such as IEEE)
4. Footnote (Humanities)

Name a few reference management tools.

Name a few reference management tools.

1. RefWorks (format bibliography and manuscripts in many referencing styles)
2. EndNote (good for papers and theses; allows networking with colleagues)
3. Zotero (good for managing Web pages)*
4. Mendeley (manages PDFs; citations and bibliographies in Word and LaTeX)*
5. VOSviewer (Good for visualization)
6. Nvivo (Good for theorizing)

*Available free.

If, in a particular area, many researchers have worked earlier and have got different results, and if the details of their experiments are available, then is it possible to analyze their results and can it lead to some conclusions?

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Yes. The method of analysis is called Meta-analysis.

The method

- Tests statistical significance of the combined results across primary research studies.
- Estimates magnitudes of data errors and correcting for these errors.
- Uses diagrams to depict publication bias, extent of heterogeneity, etc.

META Essentials software.

Today most journal papers are archived and it is possible to access thousands of past published papers in any field. How to manage the vast set of papers and yet make a literature review?

Systematic Literature Review (SLR) is now used in such a case.

Design Phase: Research question. Search Strategy (Search Term, Search Engines, Exclusion and Inclusion Criteria)

Conduct Phase: Select the Sample, Search Strategy (Title, Abstract, Full Paper, Two Reviewers)

Analysis Phase: Mining (Research Methods, Input Factors, Sample Size, etc.)
Documenting, and Analyzing the Data

Structuring and Writing the Review Phase: PRISMA Guidelines

Do you think the following items should be included in the conclusion section?

- A. Only a summary of the work done
- B. The inferences made
- C. The answers to research questions
- D. The theoretical and practical implications of the conclusions
- E. Research results conforming or contradicting the prevailing views.
- F. Limitations and future scope of the work

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| E. Research results conforming to or contradicting the prevailing views | Yes |
| F. Limitations and future scope of the work. | Yes |

Do you agree that the future scope of a Ph. D. thesis should mention one or more of the following? State Yes or No for each of the following:

- a. The direction of work if certain assumptions made in the thesis are relaxed.
- b. The way the conclusions can be implemented in practice
- c. The additional work of model refinement (if any)
- d. Parameter sensitivity analysis if that was not done in the thesis
- e. How research in other aspects of the problem can be done based on the current research outcome.

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- e. How research in other aspects of the problem can be done based on the current research outcome. Yes