

Scientific Methodology in Computer Science

MO430A

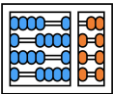
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University of Campinas



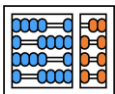
Agenda

- What is literature review?
- Types of literature review
- Steps to conduct a literature review
- Systematic literature review



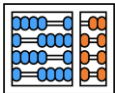
What is a literature review?

- A literature review is an in-depth critical analysis of published scholarly research related to a specific topic.
- Published scholarly research (aka, "the literature") may include journal articles, books, book chapters, dissertations and thesis, or conference proceedings.
 - Nowadays, computer science are also considering the so-called grey literature (blogs, videos, tutorials, Q&A sites, etc.)



What is a literature review?

- A solid literature review must:
 - be organized around and related directly to the thesis or research question you are developing
 - synthesize results into a summary of what is and is not known
 - identify areas of controversy in the literature
 - formulate questions that need further research
- Literature review helps you:
 - fully understand your topic
 - develop your own research ideas
 - demonstrate your knowledge in the area



Types of literature review

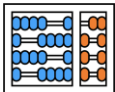
- **Critical Review:** Involves extensive research, critical evaluation of literature quality, and often results in the development of hypotheses or models.
- **Literature Review:** A broad term encompassing published materials that examine recent or current literature on various subjects, with varying levels of completeness and comprehensiveness.
- **Mapping Review/Systematic Map:** Focuses on categorizing existing literature to identify gaps for future reviews or primary research.



Grant, M.J. and Booth, A. (2009) A Typology of Reviews: An Analysis of 14 Review Types and Associated Methodologies. Health Information & Libraries Journal, 26, 91-108.

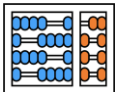
Types of literature review

- **Meta-Analysis:** A statistical technique that combines quantitative study results to provide a more precise overall effect.
- **Mixed Studies Review/Mixed Methods Review:** Combines different research methods, often incorporating a systematic literature review, such as mixing quantitative with qualitative or outcome with process studies.
- **Overview:** A summary of literature, typically in the medical field, aiming to survey and describe its characteristics.
- **Qualitative Systematic Review/Qualitative Evidence Synthesis:** Integrates and compares findings from qualitative studies to identify common themes or constructs across individual studies.



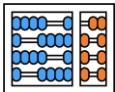
Types of literature review

- **Rapid review:** A quick assessment using systematic review methods to summarize existing knowledge about a policy or practice issue.
- **Scoping review:** A preliminary assessment to determine the extent and nature of available research literature, often identifying ongoing research.
- **State-of-the-art review:** Focuses on current matters and may offer new perspectives or suggest areas for further research.



Types of literature review

- **Systematic review:** A comprehensive review that systematically searches for, appraises, and synthesizes research evidence, often following established review guidelines.
- **Systematic search and review:** Combines critical review with a thorough search process to address broad questions and produce a 'best evidence synthesis.'
- **Systematized review:** Like a systematic review but typically conducted as a postgraduate student assignment, including some elements of the systematic review process.
- **Umbrella review:** Compiles evidence from multiple reviews into one accessible document, focusing on broad conditions or problems with competing interventions and highlighting relevant reviews.



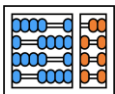
Steps to conduct a literature review



All steps and contents here on about literature review are based on:
<https://researchguides.uoregon.edu/litreview>

Identify the question

- Choose a topic that interests you! You'll be spending a lot of time with it.
- Explore your topic using textbooks, reference books, and articles and by consulting your supervisor.
- Be open to tweaking your research question as you gather more information.



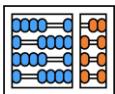
Identify the question

- According to The Craft of Research (2008), a research question is more than a practical problem or something with a yes/no answer.
- A research question helps you learn more about something you don't already know and it needs to be significant enough to interest your readers.

Your Curiosity + Significance to Others = Research Question

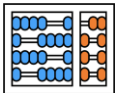


Booth, W. C., Colomb, G. G., & Williams, J. M. (2008). The craft of research (3rd ed.). University of Chicago Press.



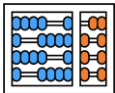
Review discipline styles

- Look at examples from your disciplinary area (humanities, social sciences, natural science, applied sciences, etc.).
- Each discipline has its own style for writing a literature review. Literature reviews in the sciences will look different from those in the social sciences and humanities.
- The best way to become familiar with literature reviews in your field of study is to look at published examples and note how they present the information.
- Pay attention to the structure of the literature reviews and primary studies.



Search the literature

- Before searching, brainstorm some keywords based on your topic
- Search systematically and keep track of your search terms; this will help you figure out which search strategies provide the best results.
- Save and organize the articles and other sources you wish to set aside for further reading



Brainstorming Keywords

1

DEFINE YOUR RESEARCH QUESTION OR TOPICS

Why? Understanding your topic before you dive into searching keeps you focused on your topic and less likely to get sidetracked by irrelevant material.

BREAK IT DOWN: PICK OUT THE CORE CONCEPTS

How? Focus on nouns or noun phrases. Avoid generic words like 'impact' that can cause you to get general or irrelevant results.

2

3

IDENTIFY RELATED TERMS FOR EACH CORE CONCEPT

Why? Search engines and some databases can suggest related topics, but it's useful to try multiple searches using similar terms.

How? Brainstorm or search online for synonyms or related words.

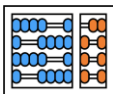
HOW IT WORKS:

- 1 What is the impact of dams on the fish of the Klamath Basin?
- 2 What is the ~~impact~~ of dams on the fish of the Klamath Basin?

- 3 **Dams** - hydroelectric dam, "Copco Number 2 Dam," diversion dam, floodgate, water management
Fish - C'waam, "Lost River sucker," Koptu, "Shortnose sucker," salmon, trout
Klamath Basin - "Klamath river," Oregon rivers, "Upper Klamath," drainage basin, watershed

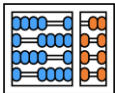
Manage your references

- As part of your literature review, you will need to provide a list of references.
- Citations are important because:
 - They help others find the information that you used.
 - They help establish the credibility of your own research.
 - They connect your work to the work of other scholars.
- Use tools to manage your references
 - Mendeley
 - Zenodo



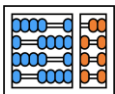
Critically Analyze and Evaluate

- Ask yourself questions like these about each article you include:
 - What is the research question?
 - What is the primary methodology used?
 - How was the data gathered?
 - How is the data presented?
 - What are the main conclusions?
 - Are these conclusions reasonable?
 - What theories are used to support the researcher's conclusions?
- It is important for you to learn how to READ an academic paper to critically analyze and evaluate a work



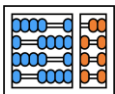
Synthesize

- To synthesize the paper found you should sort articles by themes or categories in preparation for writing your literature review.
- You can sort the literature in various ways, for example:
 - by themes or concepts
 - historically or chronologically (tracing a research question across time), or
 - by methodology



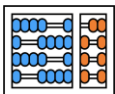
Synthesize

What is synthesis?	What synthesis is NOT:
<ul style="list-style-type: none">• Combining elements of several sources to help you make a point• Describing how sources converse each other• Organizing similar ideas together so readers can understand how they overlap• Synthesis helps readers see where you add your own new ideas to existing knowledge	<ul style="list-style-type: none">• Critiquing a source• Simply comparing and contrasting sources• A series of summaries• Direct quotes without using your own voice



How to begin?

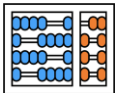
- Read your sources carefully and find the main idea(s) of each source
- Look for similarities in your sources – which sources are talking about the same main ideas? (for example, sources that discuss the historical background on your topic)
- This work can be messy. Don't worry if you have to go through a few iterations of your results as you work on your literature review!



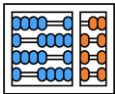


Write Literature Review

- It should cover the main findings of the various studies that have been undertaken on the topic in question but in a way that brings them together in an unfolding narrative.
- It can be organized in sections that present themes or identify trends.
- It may include relevant theory and highlight areas of controversy and questions that have yet to be fully answered.
- The goal is to provide the relevant background for your own inquiry and discussion.

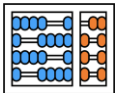


Systematic Literature Review



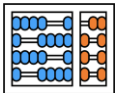
What is a Systematic Literature Review?

- A systematic literature review is a rigorous method for identifying, evaluating, and synthesizing existing research on a specific topic.
- It aims to provide an unbiased and comprehensive overview of the current state of knowledge in a particular area.
- **Systematic reviews follow a predefined protocol to ensure transparency and replicability.**

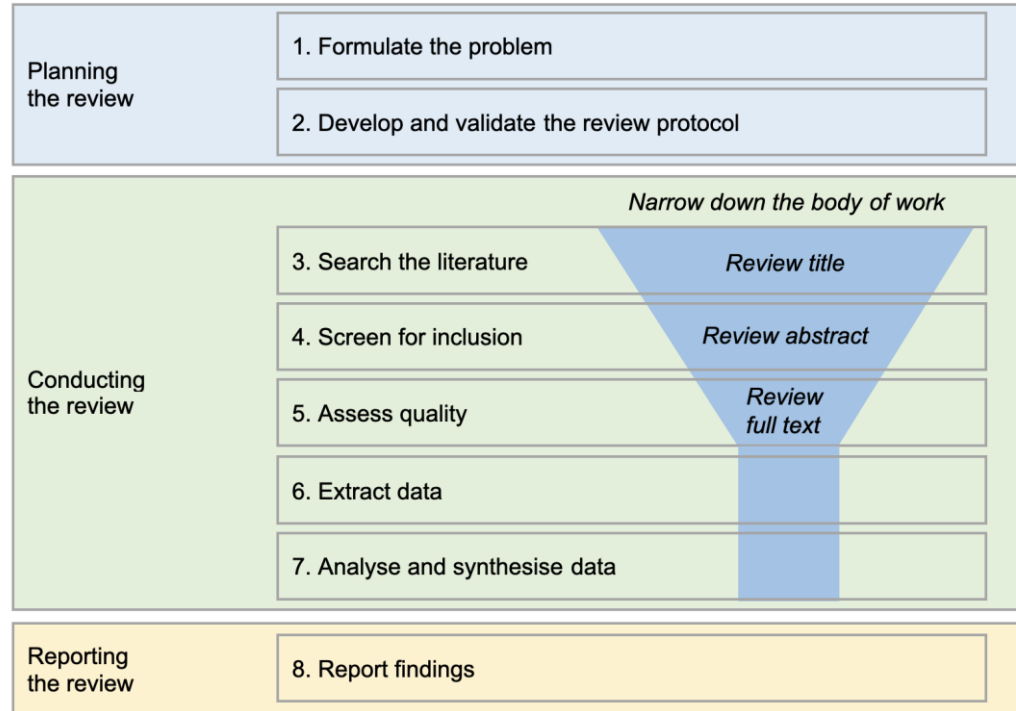


Importance of Systematic Literature Reviews

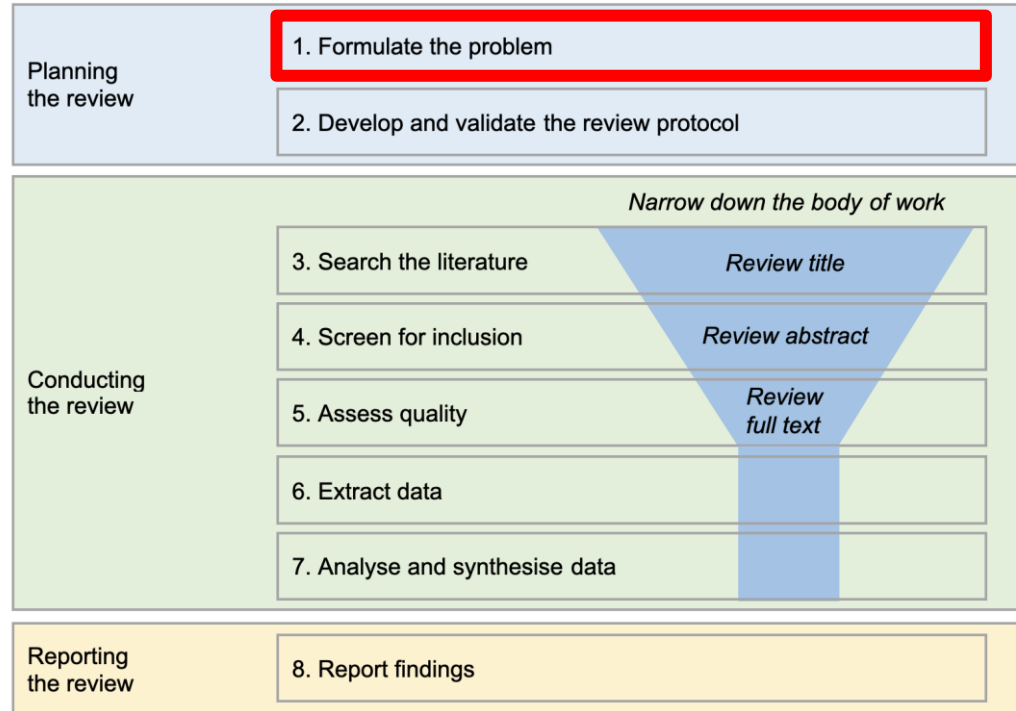
- They help identify gaps in existing research.
- They provide evidence-based insights for decision-making.
- They help establish a strong foundation for new research.
- They reduce bias and subjectivity in the review process.



The Systematic Review Process

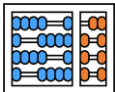


The Systematic Review Process

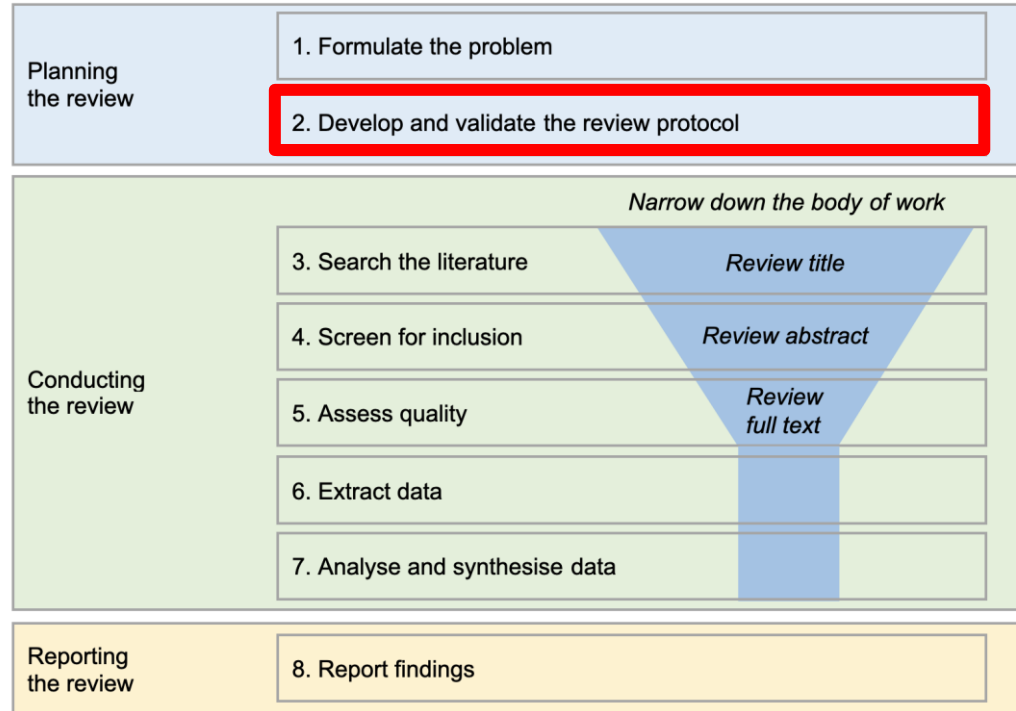


Step 1 - Formulate the Problem (Planning)

- Start by defining your research problem or question.
- Ensure it's specific, clear, and relevant to computer science.
- The problem guides the entire systematic review process.

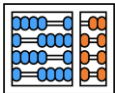


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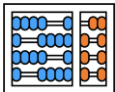
Step 2 - Develop and Validate the Review Protocol (Planning)

- Develop a detailed review protocol.
- Include clear criteria for inclusion and exclusion.
- Validate the protocol with team members to ensure consistency

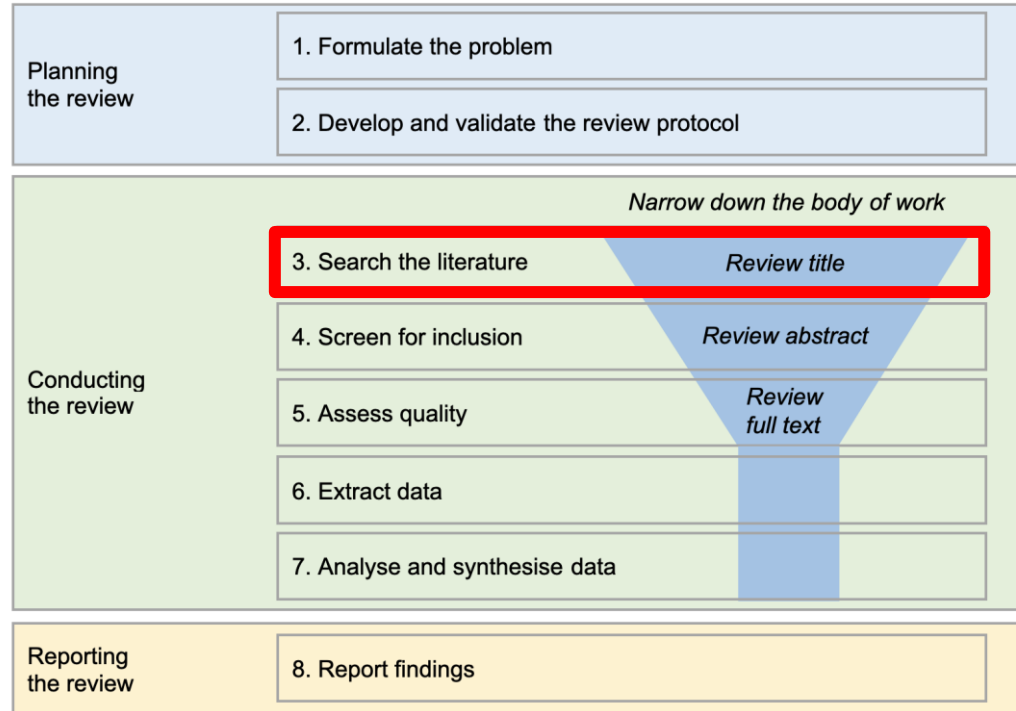


Step 2 - Develop and Validate the Review Protocol (Planning)

- Search terms:
 - Break down the question into individual facets.
 - Draw up a list of synonyms, abbreviation, and alternative spellings.
 - Pick other terms can be obtained by subject headings used in journals and databases.
 - Sophisticated search strings can then be constructed using Boolean “AND”s and “OR”s.
- Information sources
 - ACM digital library
 - IEEE Xplore
 - Scopus
 - SpringerLink
 - ...

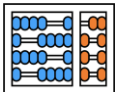


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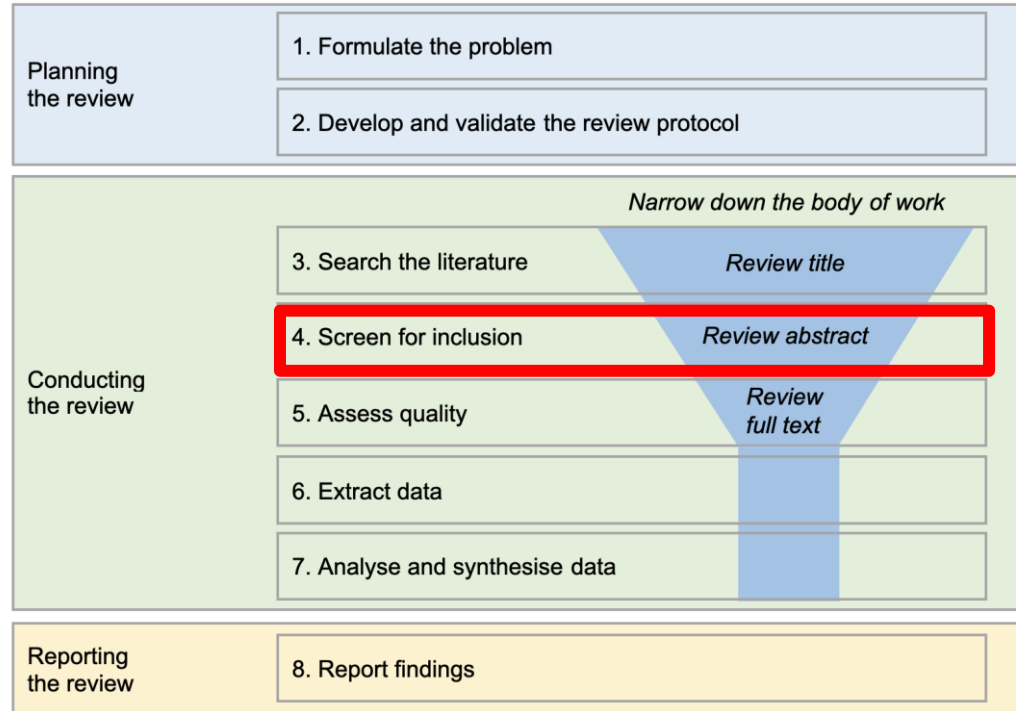


Step 3 - Search the Literature (Executing)

- Develop a comprehensive search strategy.
- Use relevant databases, journals, and conference proceedings.
- Employ Boolean operators, keywords, and filters.
- Document your search strategy for transparency.

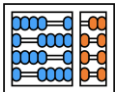


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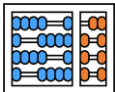
Step 4 - Screen for Inclusion (Executing)

- Screen the retrieved papers based on predefined criteria.
- Begin with titles and abstracts, then review full texts.
- Involve at least two independent reviewers.
- Resolve disagreements through discussion or a third reviewer.

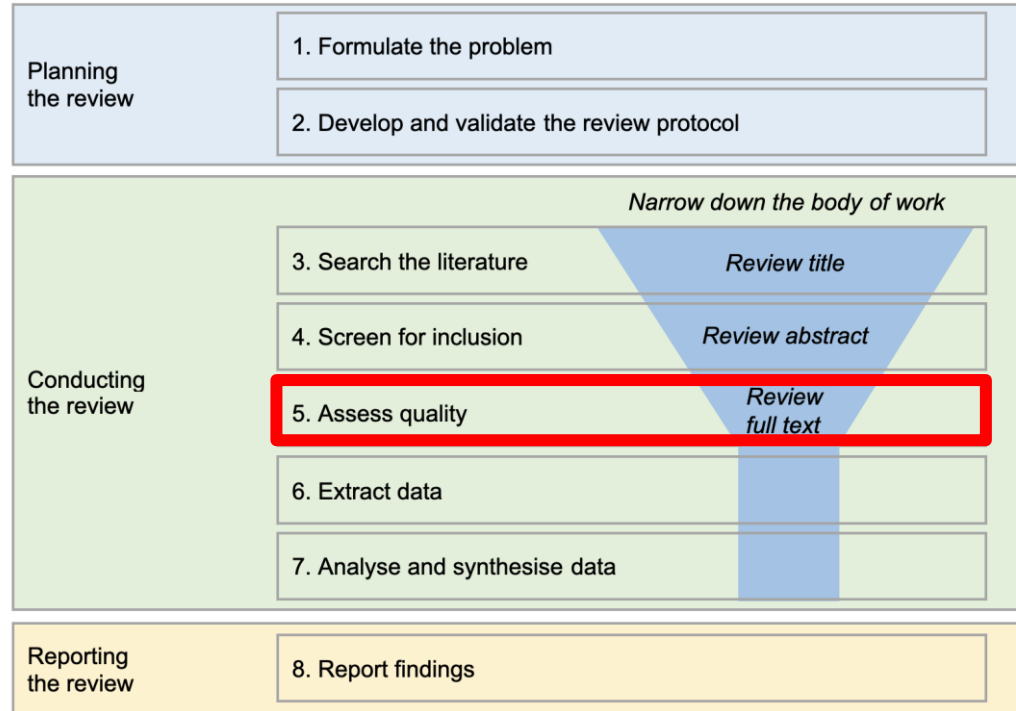


Step 4 - Screen for Inclusion (Executing)

- Three-steps screening
 - **Title and abstract:** apply the inclusion/exclusion criteria
 - **Introduction and conclusion:** apply the inclusion/exclusion criteria
 - **Full text:** apply the inclusion/exclusion criteria and quality criteria

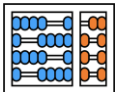


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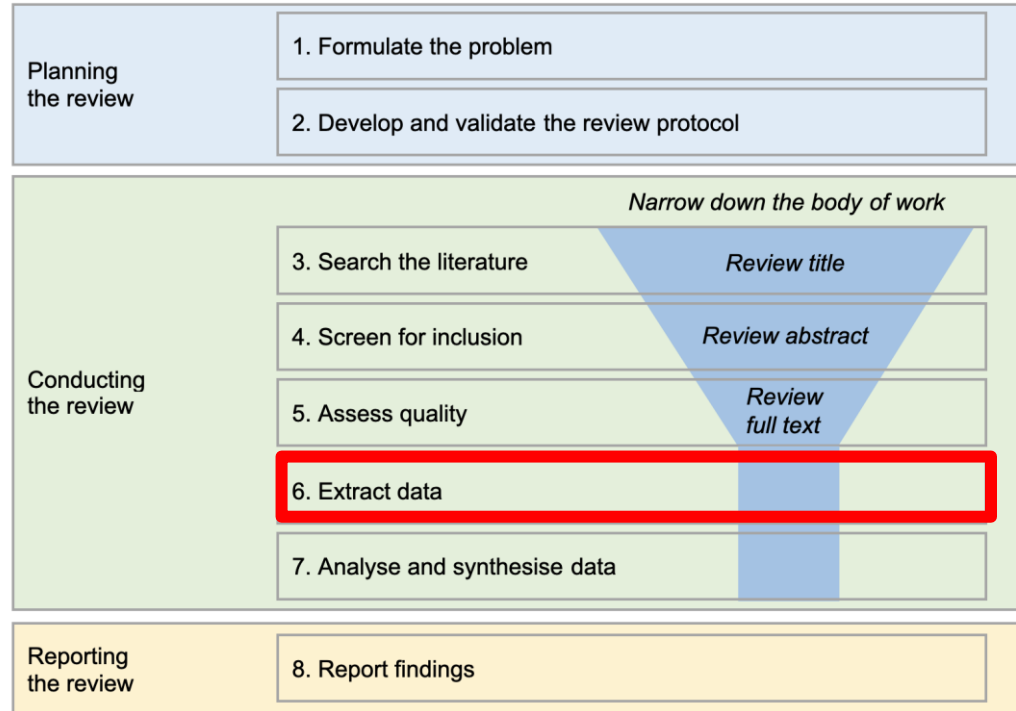


Step 5 - Assess Quality (Executing)

- Evaluate the quality and risk of bias in each selected study.
- Use established assessment tools.
- Consider factors like study design, sample size, and data collection methods.
- Document the quality assessment process.

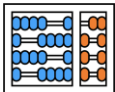


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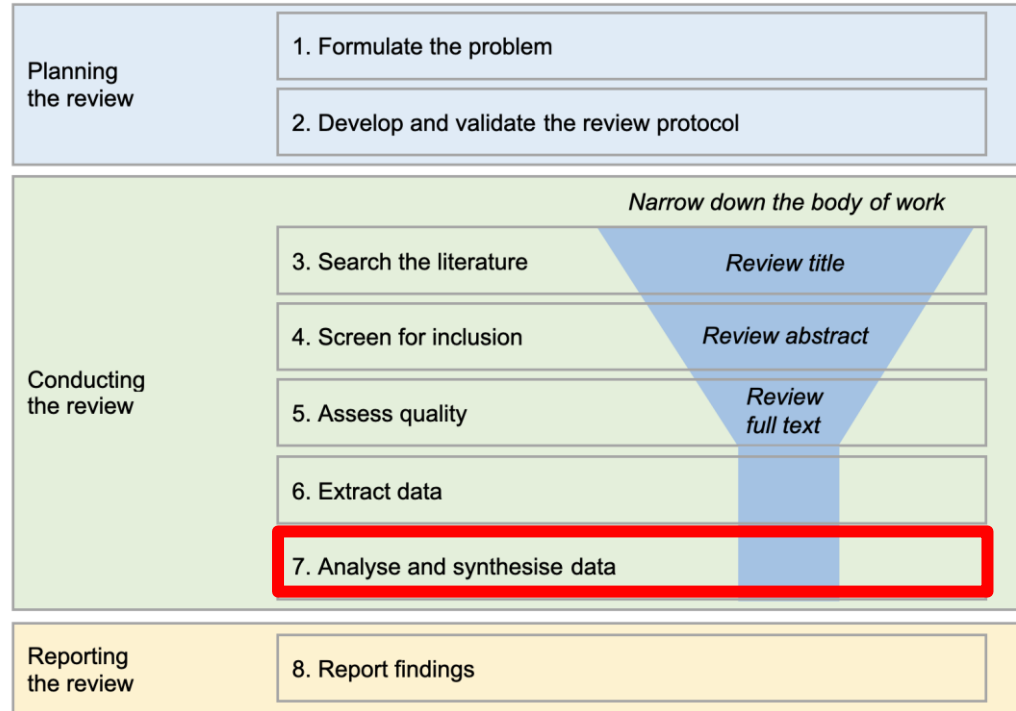


Step 6 - Extract Data (Executing)

- Develop a structured data extraction form.
- Collect relevant information from each included study.
- Ensure consistency in data extraction.
- Keep detailed records of extracted data.

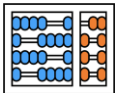


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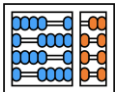
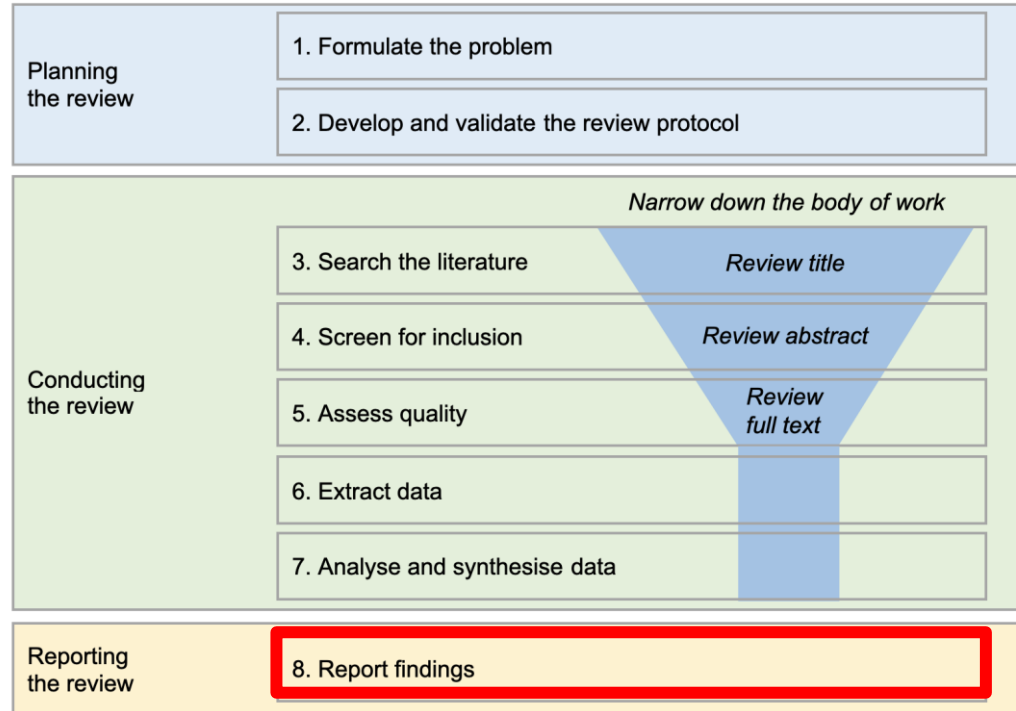


Step 7 - Analyze and Synthesize Data (Executing)

- Summarize key findings from each included study.
- Identify patterns, trends, and discrepancies.
- Consider conducting a meta-analysis if applicable.
- Use visuals and tables to present results.

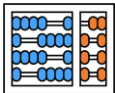


The Systematic Review Process



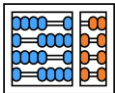
Step 8 - Report Findings (Reporting)

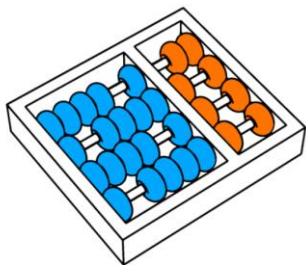
- Follow established reporting guidelines (e.g., PRISMA).
- Include sections on objectives, methods, results, and discussion.
- Transparently report the search strategy, inclusion/exclusion criteria, and quality assessment.



Homework

- Find a Systematic Literature Review from your area
- Identify the steps presented here in the paper
- Read the complimentary material available in Google Classroom





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