COMP0190 Project Preparation T2 Module

MSc Artificial Intelligence for Sustainable Development (AI4SD)

MSc Artificial Intelligence for Biomedicine and Healthcare (AI4BH)

Prof. Delmiro Fernandez-Reyes
Monday 3rd February 2023

The Literature Review
Part 01

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- Some books are to be tasted, others to be swallowed, and some few to be chewed and digested; that is, some books are to be read only in parts; others to be read, but not curiously; and some few to be read wholly, and with diligence and attention.

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English philosopher who pioneered **the scientific method** and **empiricism** which emphasizes evidence, especially as discovered in experiments.

Why and What is a Literature Review

- To give an overview of a topic's background – [what has been done **or** haven't been done]
- To identify existing gaps in current knowledge
- To understand a topic more deeply
- With the aim to define the scope, context and hypotheses of a research study

A literature review in research methodology is a comprehensive analysis and evaluation of the existing body of knowledge on a particular research topic. It surveys and summarizes the existing research studies and articles, identifies gaps in current knowledge, and highlights the need for further research.

It aims to establish the background and context of the research problem and provides a foundation for the research study.

Asking ChatGPT*:

"what is a literature review in research methodology in the style of the English philosopher Francis Bacon"

A literature review in the style of Francis Bacon would involve critically evaluating existing works and theories related to the research topic, with a focus on finding evidence to support or challenge the ideas being studied. This approach would align with Bacon's belief in empirical observation and the use of inductive reasoning to form conclusions based on facts and evidence. The literature review would aim to identify gaps in knowledge and provide a solid foundation for conducting original research and drawing new conclusions.

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Why and What is a Literature Review

- Critically evaluate existing works and theories related to the research topic
- Focusing on finding evidence to support or challenge ideas being studied
- Use found facts and evidence to form conclusions
- Identify gaps in knowledge and provide a solid foundation for original research
- Conduct original research and draw new conclusions.
- All empirical studies —qualitative, quantitative, or mixed methods— must be:
    - Linked to literature or concepts that support the need for the study
    - Be related to the study's purpose statement
    - And situate the study in terms of previous work

Literature Review - Theoretical and Conceptual Frameworks

- A literature review often includes theoretical and conceptual frameworks
- Terms are often used interchangeably and they share five functions in common:

1. to build a foundation: using previous work to demonstrate linkages, illustrate trends, and provide an overview of a concept theory, or literature base
2. to demonstrate how a study advances knowledge: use the literature to present existing knowledge building a case that shows the gap in what is known that a study will address
3. to conceptualize the study: occurs by describing hypothesis and propositions of previous studies, defining terms, and clarifying assumptions and limitations citing relevant work to build a rationale for a study
4. to assess research design and instrumentation: making a case for the method considered to be appropriate and by illustrating why other methods are not, citing related work
5. to provide a reference point for interpretation of findings: comparison of results and the implications connected to previous research

Literature Review - Theoretical and Conceptual Frameworks

Literature Review:

- Summarises existing literature related to research question or topic
- Provides context and background information
- Identifies gaps in existing knowledge
- Establishes basis for current study

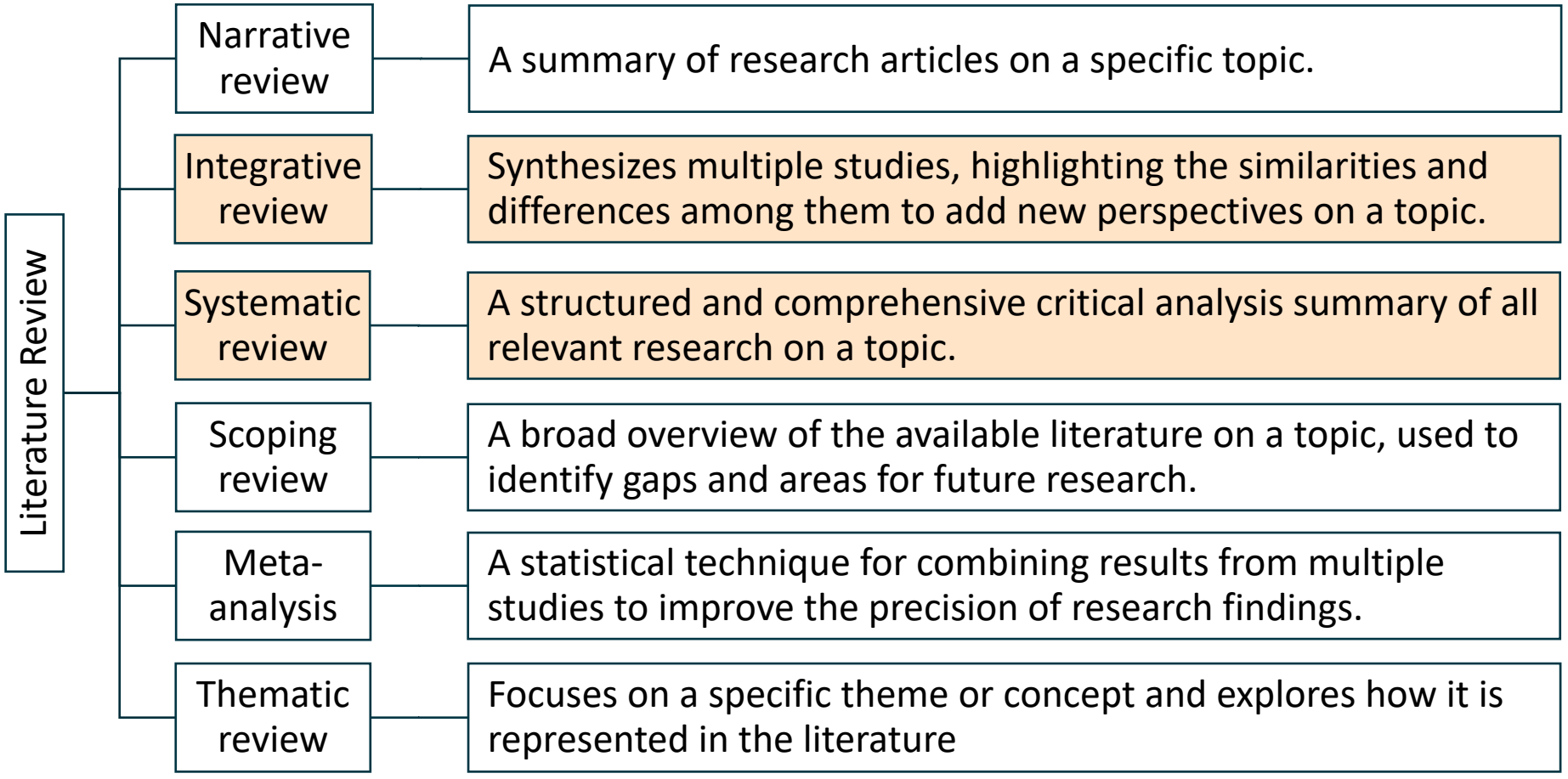
Theoretical and Conceptual Framework:

- Theoretical ideas, concepts, and models that form basis for study
- Provides roadmap or structure for research
- Defines key concepts and variables
- Identifies relationships among concepts and variables
- Guides research design, data collection and analysis
- Helps interpret research results

In summary:

- The Literature review and theoretical and conceptual frameworks are two distinct yet related components in a research project.
- The literature review informs the theoretical and conceptual frameworks, which in turn guides the research study.

Literature Review - Types



Literature Review - Qualities

Quality	Systematic Review	Integrative Review
Rigorous	Yes	No
Transparent	Yes	No
Comprehensive	Yes	No
Evidence-Based	Yes	Yes
Replicable	Yes	No
Critical	Yes	Yes
Synthetic	No	Yes
Interpretive	No	Yes
Reflective	No	Yes
Up-to-Date	Yes	Yes

Literature Review Process – Phases / Steps

1. Formulate a clear research question
2. Define inclusion and exclusion criteria
3. Develop and evaluate the review protocol

planning

4. Conduct a comprehensive and systematic search for relevant studies
5. Screen the titles and abstracts to determine eligibility for inclusion in the review
6. Assess the full text of eligible studies for quality and relevance
7. Extract relevant data from eligible studies
8. Synthesize the data extracted from eligible studies
    a. Narrative synthesis, meta-analysis, or qualitative synthesis
    b. Synthesis of findings from multiple studies
9. Evaluate the quality of the evidence and the risk of bias
10. Draw critical conclusions and refine research hypotheses

conducting

11. Make recommendations based on the evidence synthesized in the review
12. Disseminate the findings of the review

reporting

planning

- Drive the entire systematic / integrative / structured review methodology.
- Cover the subject area or problem within the scope of the project
- Closely linked to a project aims, objectives and hypotheses
- A specific problem (*P*) is tackled using some specific constraints, methods and/or approaches (*C*) to develop a solution, system, application or algorithm (*S*)
- Identify what existing solutions are available and how they compare
- What is the strength of the evidence is and what implications these solutions have
- **RQ1** What are the existing solutions to *P*?
- **RQ2** How does different solutions addressing RQ1 compare to each other with respect to *C*?
- **RQ3** What is the strength of the evidence in support of the different solutions?
- **RQ4** What implications will these findings have when creating *S*?

planning

- Defines how each step is to be carried out to support reproducibility.
- A pre-defined protocol is necessary to reduce researcher bias.
- The rationale and the research questions that the review is intended to answer.
- Search strategy: for primary studies including search terms and resources to be searched.
- Study selection criteria: determine which studies are included or excluded
- Study selection procedures: how the selection criteria will be applied.
- Study quality assessment: checklists and procedures.
- Data extraction strategy: how information required from primary studies will be obtained.
    - If the data require manipulation or assumptions and inferences to be made, the protocol should specify an appropriate validation process.
- Synthesis of the extracted data: synthesis strategy it should clarify what type of review
- Dissemination strategy and project timetable

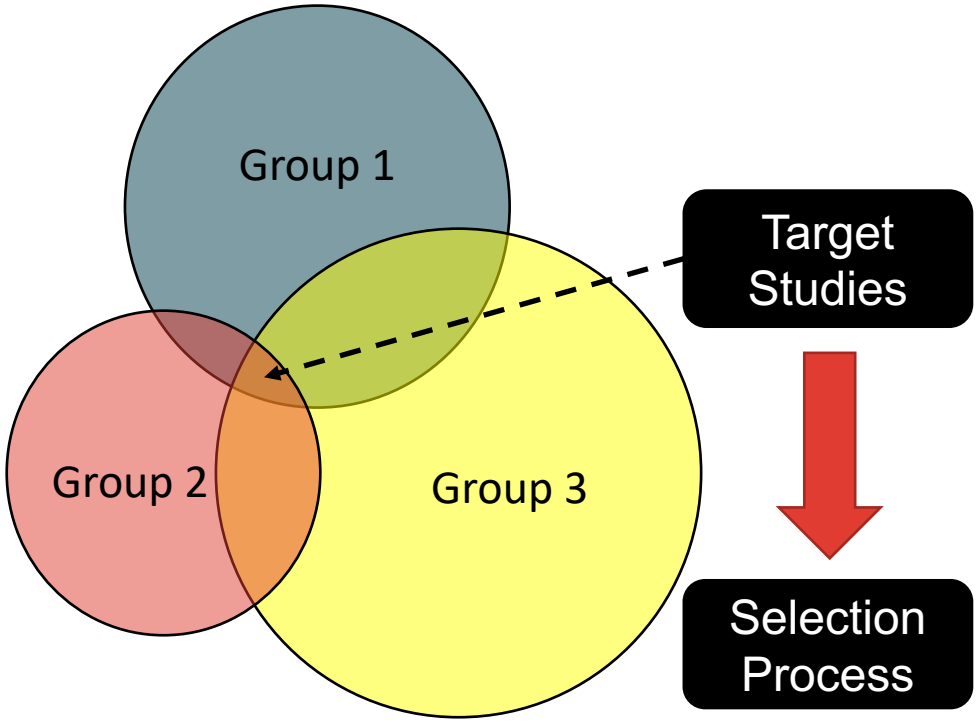
conducting

- Retrieve all the literature relevant to the defined research questions.
- A search strategy must be defined.
- The search process aims to identify primary studies address the research questions.
- Should specify which sources to be searched and how to search them
- Searched sources include digital libraries, journals and conferences relevant to the area.
- Terms chosen should be closely related to the first research broader question.
- Define specific search terms and the procedure for searching the sources.
- Search strings are formed by grouping key terms into groups.
- Could contain terms that are either synonyms, different forms of the same word.
- Groups can be designed to retrieve different sets of the relevant literature.

conducting

- Implement search strategy by
  - applying OR operator within the groups
  - and AND operator between the groups.
  - (([G1,T1] OR [G1,T2]) AND ([G2,T1] OR [G2,T2] OR [G2,T3]) AND ([G3,T1] OR [G3,T2]))
- The primary goal is to find the literature that is the intersection of the sets

	Group 1	Group 2	Group 3
Term 1	*Synonym 1*	*Synonym 2*	*Synonym 3*
Term 2	*Synonym 1*	*Synonym 2*	*Synonym 3*
Term 3		*Synonym 2*	



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- *Primary study*: An empirical study investigating a specific research question.
- *Secondary study*: reviews primary studies

  with the aim of integrating/synthesising evidence of a specific research question.
- *Meta-analysis*. A form of secondary study

  where research synthesis is based on quantitative statistical methods.
- *Tertiary study*: A review of secondary studies related to the same research question.

- *Publication bias*: positive results are more likely to be published than negative results.
- The concept of positive or negative results could depends on the researcher viewpoint.

conducting

- Bibliography Management and Document Retrieval
- A reference manager (Endnote, Zotero, Mendeley) useful.
- The search process needs to be documented
- Unfiltered search results should be saved and retained for possible reanalysis
- Specify rationale for digital libraries and journal and conference proceedings to be searchedx

Data Source	Documentation
Digital Library	Name Search strategy for the database Date of search Years covered by search
Other sources	Date Searched/Contacted URL Any specific conditions pertaining to the search

conducting

- Identify those primary studies that provide direct evidence
- Decided during the protocol definition and refined during the search process
- Inclusion and exclusion criteria should be based on the research question
- General removal criteria:
  - Duplicates (keep the highest ranking source)
  - The same study published in different sources (keep the highest ranking source)
  - Studies published before a certain date (or even after).
- Inclusion criteria define the characteristics that studies must have in order to be considered relevant to the review, such as specific populations, interventions, or outcome measures.
- Exclusion criteria define the characteristics that make a study ineligible for inclusion, such as studies that lack a control group or those that are duplicates of other studies.
- The purpose of inclusion and exclusion criteria is to ensure that the review is focused, relevant, and rigorous.

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Simple Example:

Study comparing AI methodologies in the biomedical and healthcare domain

Inclusion criteria:

- Studies comparing AI methodologies used in the biomedical and healthcare domain
- Studies reporting performance of accuracy, precision, recall, or other relevant metrics
- Studies that evaluate AI methodologies for relevant domain specific applications
    - disease diagnosis, drug discovery, or medical imaging
- Studies that use real-world data sets or relevant simulated data sets
- Studies published in peer-reviewed journals between the years 2015-2022

Exclusion criteria:

- Studies that do not report quantitative results on the performance of AI methodologies
- Studies that use small or limited data sets
- Studies that have not been peer-reviewed or published in scientific journals.

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It is considered critical to assess the "quality" of primary studies

- Adds rigour to general inclusion/exclusion criteria selection
- Provides a more detailed inclusion/exclusion criteria
- What is the strength of the evidence in support of the different solutions?
- To assess whether quality differences provide an explanation for differences in study results
- As a means of weighting the importance of individual studies when synthesising results
- To guide the interpretation of findings and determine the strength of inferences
- To guide recommendations for further research

conducting

Examples:

- Is there is a clear statement of the aim of the research?
- Is the study is put into context of other studies and research?
- Are system or algorithmic design decisions justified?
- Is the test data set reproducible?
- Is the study algorithm reproducible?
- Is the experimental procedure thoroughly explained and reproducible?
- Is it clearly stated in the study which other algorithms the study's algorithm(s) have been compared with?
- Are the performance metrics used in the study explained and justified?
- Are the test results thoroughly analysed?
- Does the test evidence support the findings presented?

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conducting

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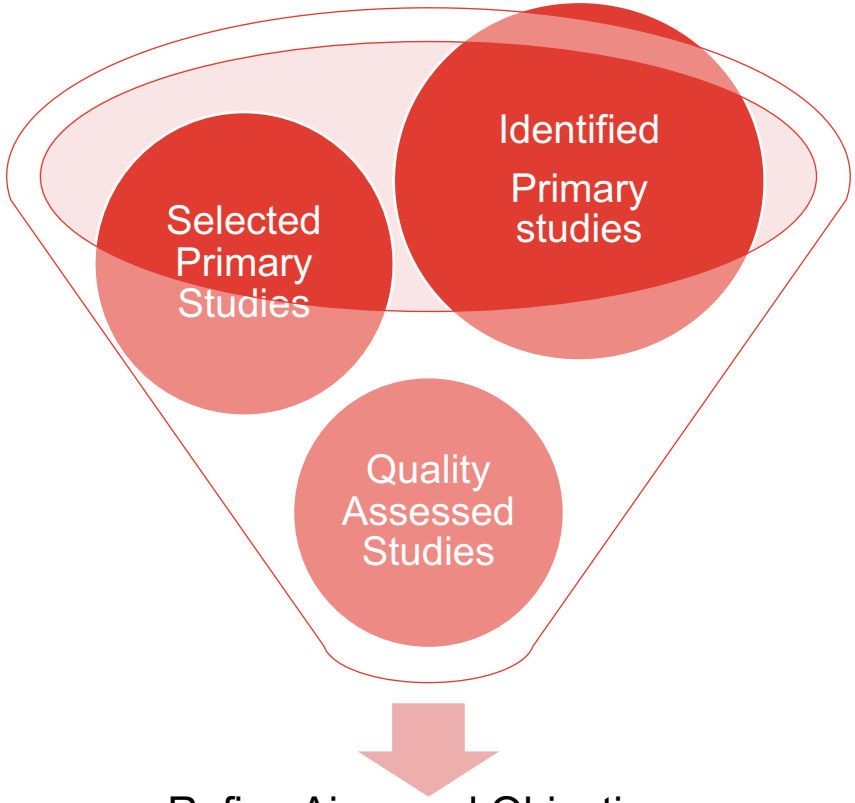
reporting

Literature Review Process – Why are we doing this?

General Background

Supporting Studies



Refine Aims and Objectives

Refine Hypotheses

Refine Research Methodology