Systematic Reviews

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NYT C02

Agenda

1. Systematic reviews
2. Research design
3. Study search
4. Study filter
5. Data analysis
6. Quality assurance

1. Systematic Reviews

Literature Review

A **literature review** is a

- Review of existing literature for purposes of theory building

In a literature review

- **Relevant literature is sought out,**
- **Analysed** towards a research question, and
- **Synthesized** towards an answer, the new or revised theory

A literature review should follow a systematic literature review methodology

Types of Literature Reviews

Types of literature reviews

- Traditional or narrative literature reviews
- Systematic literature reviews
- Meta-syntheses

Related, but not a type of literature review as defined here

- Meta-analyses

Not a (scientific) type of literature review

- Related work (review)

Related Work Review

A related work review is a research practice which

- **Compares and contrasts** existing research with current or planned research

A related work review is most commonly performed

- In a research paper to bring out what is novel about the presented work
- In a final thesis to clarify the thesis work' relationship to existing work

In other words, it is a justification for what's to be presented

Traditional or Narrative Literature Reviews

Traditional (or narrative) literature reviews

1. **Choose research question** to answer using traditional literature review
2. **Perform comprehensive** (researcher-expertise-driven) **search** for literature
3. **Evaluate relevance** (strengths and weaknesses) of found literature
4. **Summarize findings** with respect to research question

Traditional literature reviews

- Lack rigor (but rely on the researcher's expertise)
- Are best viewed as well-reasoned opinions [DR]

Systematic Literature Reviews (SLRs)

SLRs are a systematic approach to

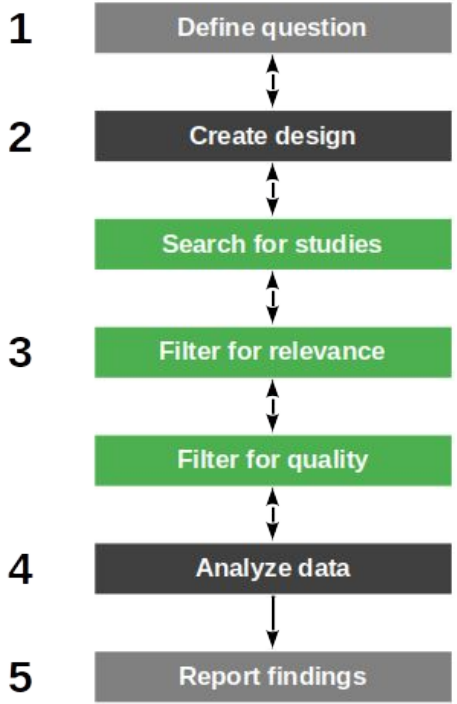
- Finding, analyzing, and synthesizing primary studies

SLRs are a form of systematic review

- Not all systematic reviews are SLRs (but most are)

Common methodology descriptions include

- Kitchenham et al. (2023), Booth et al. (2016)



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Meta-Syntheses

Meta-syntheses are structured literature reviews that

- Perform theory building using a research method, for example,
  - Braun & Clarke (2012): Thematic analysis
  - Corbin & Strauss (2008): Grounded theory

Meta-Analyses

Meta-analyses are literature analyses that

- Quantitatively aggregate findings from different studies
- Derive a more comprehensive statistical conclusion to a hypothesis

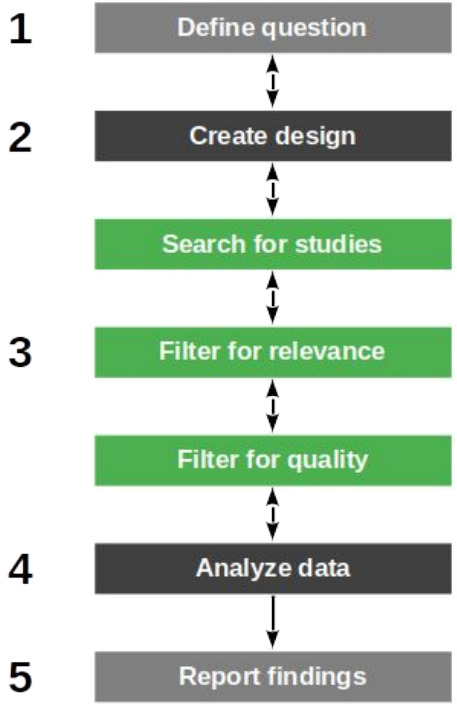
Meta-analyses are not theory building, but hypothesis testing research

2. Research Design

Systematic Literature Reviews (SLRs)

The SLR process consists of

1. **Defining the research question**
2. **Designing the systematic review**
   a. **Create research design**
   b. **Create research protocol**
   c. **Review research protocol**
   d. **Register research protocol**
3. Performing the review
   a. Search for studies
   b. Filter for relevance
   c. Filter for quality
4. Analyze data



Define Research Questions

SLRs are open to any research question

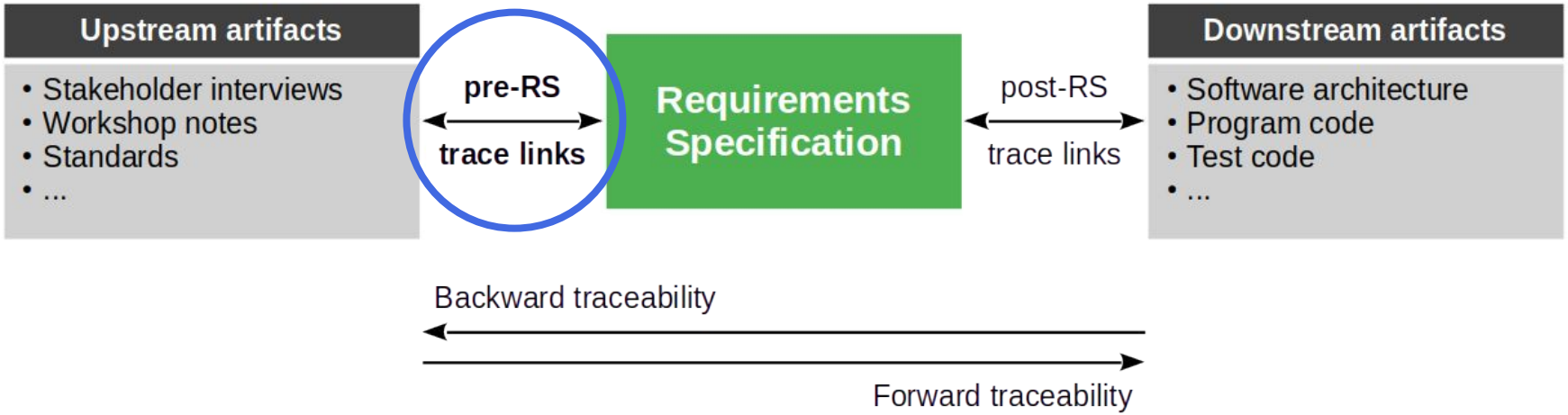
- They rely on primary materials
- Are a type of secondary study

SLRs are useful for

- Summarizing existing evidence
- Identifying gaps in current research
- Building a new research framework (theory)

Example Research Question

Benefits of pre-Requirements-Specification traceability



Primary Materials / Literature

Primary materials (for an SLR) is original research

- Usually as presented in publications (i.e. literature)
- But also (but rarely) as the original research artifact

Be cautious to include gray literature and explain if so

- Gray literature is non-peer-reviewed work
- Examples are practitioner articles like blog posts

Create Research Design

Steps to take

1. Define tasks and activities
2. Choose research methods
3. Choose supporting tools
4. Write research protocol

For activities and methods

- See the following sections

Tasks and Activities + Methods and Practices

Define and document tasks/activities and associated methods/practices

- Study search (databases, search queries, …)
- Relevance filter (inclusion/exclusion criteria, …)
- Quality filter (research quality model, …)
- Analysis method (e.g. thematic analysis)

Support Tools

Progress tracker

- Lab book [1]

Literature manager

- Zotero, Mendeley
- ResearchGate
- File system

[1] A.k.a. log book, work log

Create Research Protocol

Document your plan in a research protocol; this includes

- Meta information
- Research question
- Research design
  - Overall process
  - Tasks and activities
  - Methods and practices

Document the what and explain the why of your choices

Protocol Using Prisma Statement [1] 1 / 2

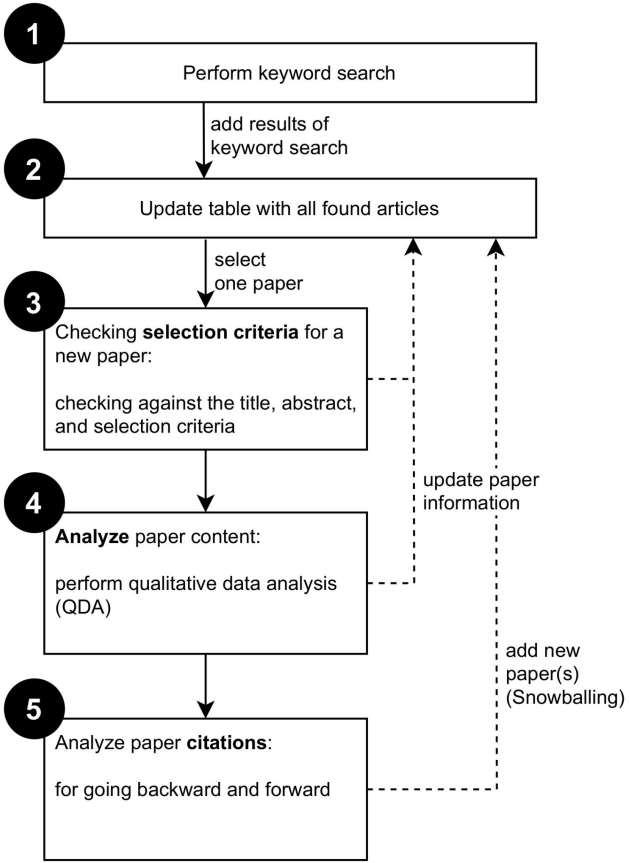
Section and topic	Item No	Checklist item
ADMINISTRATIVE INFORMATION		
Title:		
Identification	1a	Identify the report as a protocol of a systematic review
Update	1b	If the protocol is for an update of a previous systematic review, identify as such
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number
Authors:		
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments
Support:		
Sources	5a	Indicate sources of financial or other support for the review
Sponsor	5b	Provide name for the review funder and/or sponsor
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol
INTRODUCTION		
Rationale	6	Describe the rationale for the review in the context of what is already known
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)

[1] See https://prisma-statement.org/protocols/

Protocol Using Prisma Statement 2 / 2

METHODS		
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated
Study records:		
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)

Visualization of Research Design Process



In addition to prose descriptions

- Visualize the workflow

Strong in papers and theses

Review Research Protocol

Ask your peers or pay outside experts for feedback

- Consider using Spall (1998) for peer debriefing

Iterate until satisfied

Register Research Protocol

Upload to arXiv (or similar registry / archive)

3. Study Search

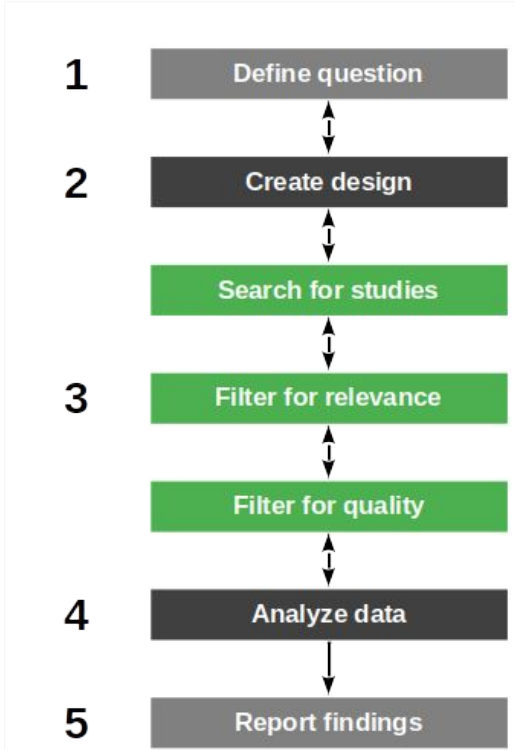
The Search Process

Searching for studies

1. **Define scope of search**
2. **Express scope as search query**
3. **Search and evaluate basic fit**
4. **Document the process [1]**

Filtering the studies

5. Filter for relevance
6. Filter for quality



[1] See Rethlefsen et al. (2021): Reporting literature searches in systematic reviews.

Define Scope of Search

The search scope follows from the research question

Components of the scope definition can be

1. Research-question-specific terms
2. Meta-criteria like
    a. Year / age of literature
    b. Publication outlet
    c. Type of article
    d. Written language of article
    e. Number of citations

Specify both inclusion and exclusion criteria!

Express Scope as Search Query

Codify scope as search query, usually

1. By conjunction of search terms
2. Choice of search engines, for example,
    a. Google Scholar
    b. ACM Digital Library
    c. IEEE Press Digital Library
    d. Commercial libraries e.g. Elsevier, Springer, Wiley

To learn more about commercial libraries, see

- https://deal-konsortium.de/
- https://sci-hub.ru/

Example Search Query

Benefits of pre-Requirements-Specification traceability

- “pre-requirements specification traceability” OR
  “pre-requirements specification” OR
  “requirements provenance”

Example Keywords and Statistics

Search term	Google Scholar	IEEE DL	ACM DL	Web of Science
“pre-requirements specification traceability”	62	7	1	1
“pre-requirements specification”	133	20	6	1
“requirements provenance”	42	1	2	11

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Evaluate Basic Fit

Perform search using search query and search engine

For each found article, review its basic fit towards search scope

For each relevant article, perform forward and backward snowballing [1]

- Backward snowballing: Review reference list of article at hand
- Forward snowballing: Search for articles citing the one at hand

Snowballing may well lead you to change the search query!

[1] See Wohlin (2014): Guidelines for snowballing in systematic literature reviews.

Basic Fit Criteria

Basic fit criteria are formal criteria to include or exclude literature

1. English language?
2. Peer-reviewed publication?
3. A primary study?

The decision should be made at a glance

Document the Search Process

Document search queries, for example,

- Date of search
- Name of library

Document results of search queries, for example,

- Article reference
- Location (URL)

Use log book for documentation

4. Study Filter

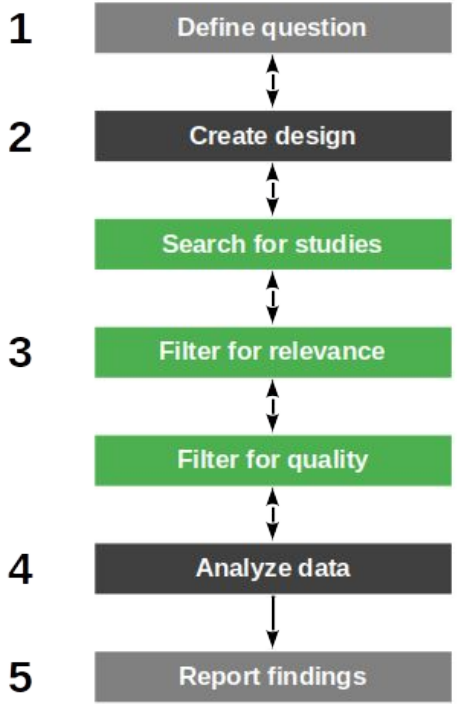
The Filtering Process

Searching for studies

1. Define scope of search
2. Express scope as search query
3. Search and evaluate basic fit
4. Document the process [1]

Filtering the studies

5. **Filter for relevance**
6. **Filter for quality**



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Filter for Relevance

For each retrieved article

- First read title
- Next read abstract
- Finally read article, if necessary

Use inclusion and exclusion criteria to

- Keep or drop the article at hand

If possible, use second researcher to perform same task

- Ensure that disagreements are discussed and resolved

Inclusion and Exclusion Criteria

Use the research question to define

- Inclusion criteria (keep study)
- Exclusion criteria (drop study)

Ensure reliability of interpretation

- Try to operationalize criteria
- Have second researcher

Example Relevance Criteria

1. Is it a duplicate?
2. Is it written in English?
3. Is it the right type of study?
4. Does it fit the research question?

Filter for Quality

For each relevant article

- Read the article carefully
- Qualify the article
- Filter the article

Quality Filters

Use an existing quality model [1] or create your own

Rank order by type of research, for example,

- Controlled experiments over case studies
- Case studies over qualitative surveys

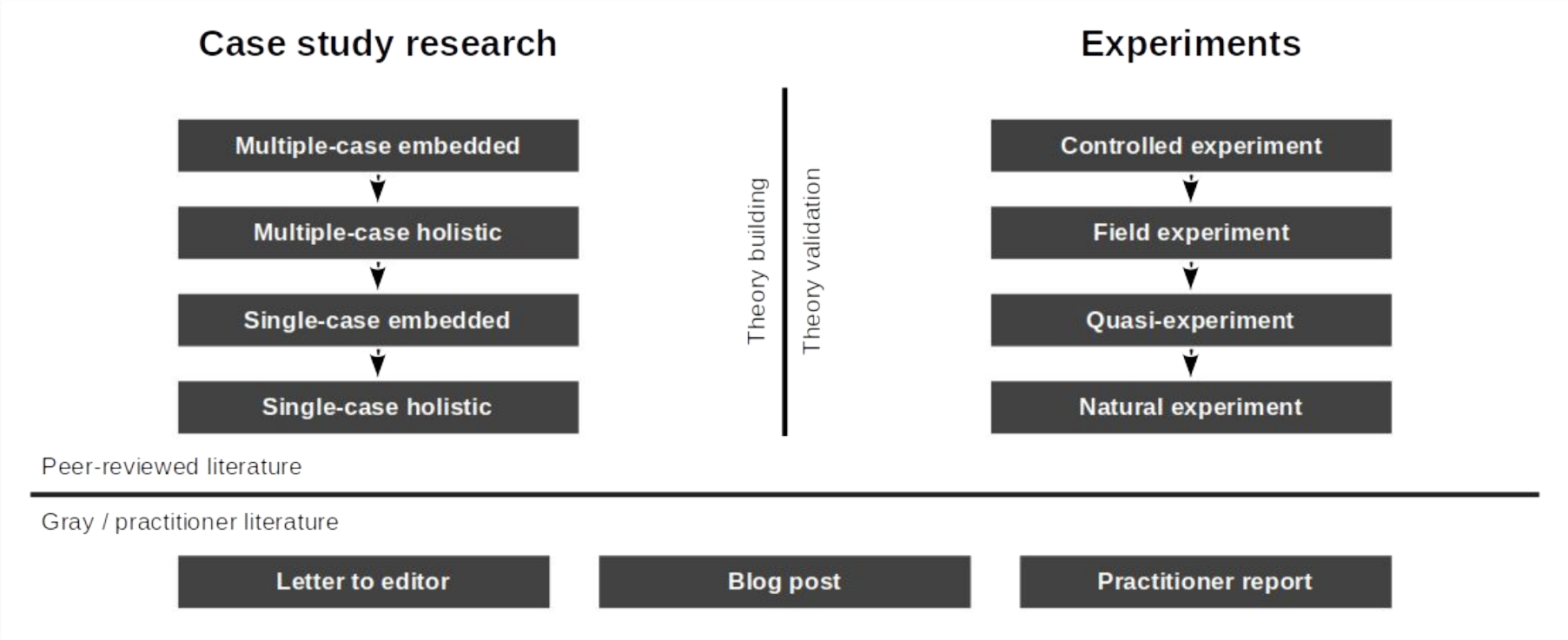
Within each type of research, create quality levels, for example based on

- Scope / breadth of evidence
- Recognized biases

Define a minimum expected quality level as the filter

[1] For example, the OCEBM Levels of Evidence model, see https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocebm-levels-of-evidence

Illustration of Potential Quality Model and Its Problems



Dealing with Gray Literature

Gray literature can be included if

- It is important for the research question

Gray literature can be excluded if

- There are enough on-point primary studies

See Booth et al. (2016), p. 120, for a discussion of gray literature in SLRs

Document the Filtering Process

Document decisions for inclusion or exclusion

- The actual decision taken
- The reason for the decision (which criterion matched or was violated)

Track numbers along the search and filter funnel; at least the three stages

1. Is returned by query
2. Describes a relevant study
3. Passes expected quality threshold

4. Data Analysis

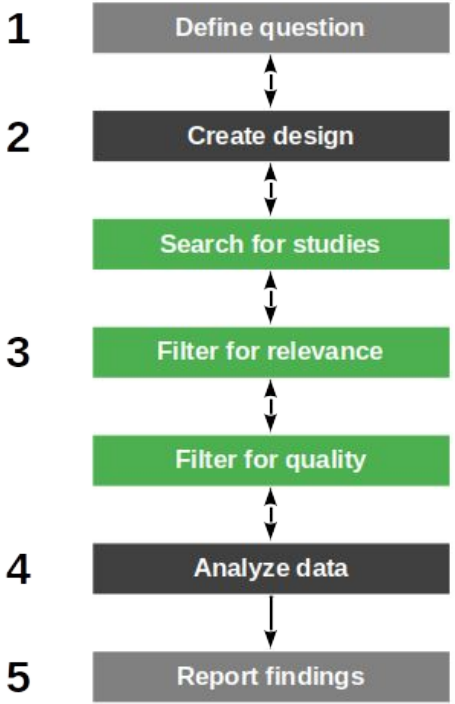
Data Analysis

Analyze data can be split into

- Extract data
- Synthesize data

There are two types of data

- Descriptive metadata i.e. statistics
- Content used for theory building



Extract Descriptive Data

Extract relevant statistical data from articles

1. Total number of articles
2. Keyword-article relationship
3. Trace to article (keyword, snowballing)
4. No citations by article (distribution)
5. Year of publication (distribution)
6. …

Focus on the article metadata, not the content

Interpret Descriptive Data

Interpret the data using simple means

- To recognize keyword trends
- To recognize publication trends

Some descriptive analysis may also be interesting

- Who is publishing?

Qualitative Data Analysis

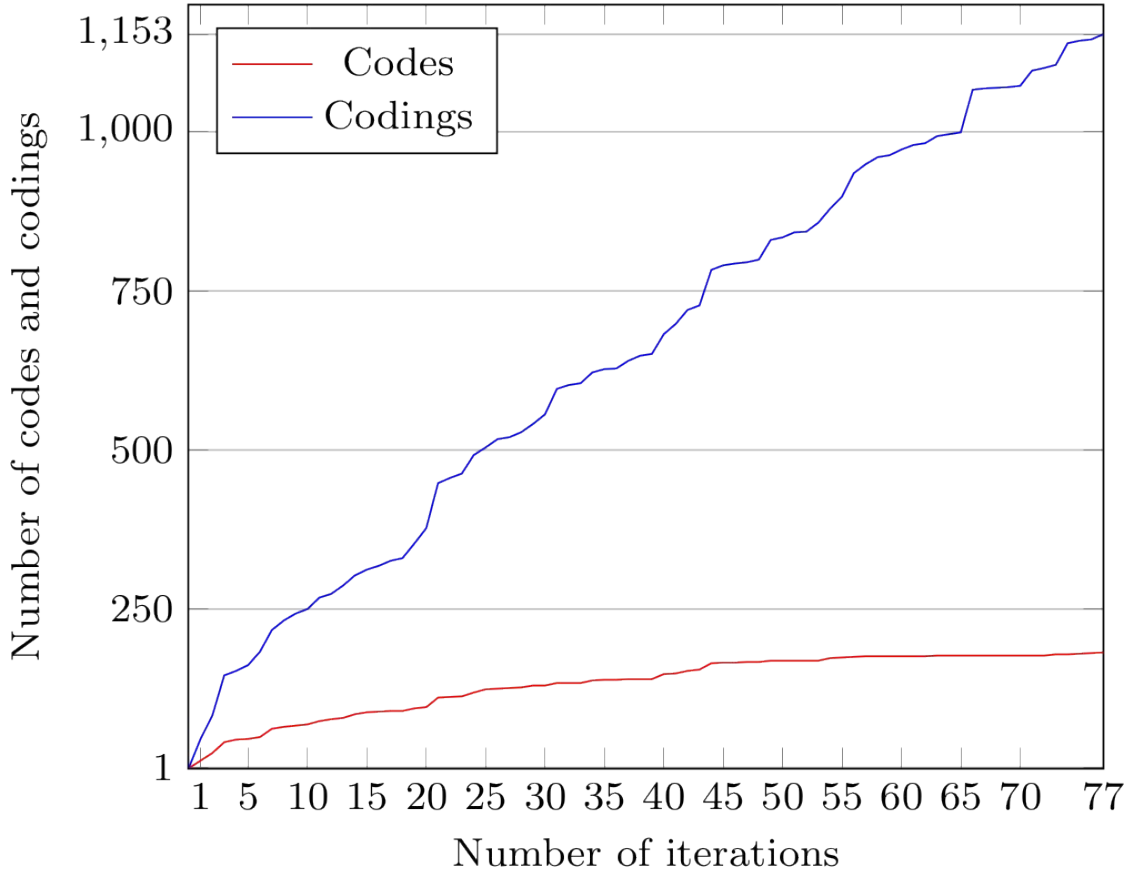
Perform qualitative data analysis using an appropriate method, e.g.

- Corbin & Strauss (2012): Grounded theory
- Brown & Clarke (2012): Thematic analysis

Example Coding Statistics

Codes	Number of codings
Requirements Traceability	5
Pre-RS traceability general (+ subcodes)	81
Applying pre-RS traceability (+ subcodes)	31
Use cases and benefits	249
Problems and challenges (+ subcodes)	275
Consequences of poor pre-RS traceability	5
Solutions and suggestions (+ subcodes)	258
Trace techniques (+ subcodes)	212
Trace tools (+ subcodes)	48

Example Demonstration of Saturation



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5. Quality Assurance

Relevant Quality Criteria

1. Clear selection criteria
2. Complete and exhaustive
3. Clear documentation of methods
    a. Searching and filtering
    b. Data analysis
4. Clear chain of evidence to results

Summary

1. Systematic reviews
2. Research design
3. Study search
4. Study filter
5. Data analysis
6. Quality assurance

Thank you! Any questions?

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