An Introduction to Scientific Writing

Research Software Engineering Management and Communication

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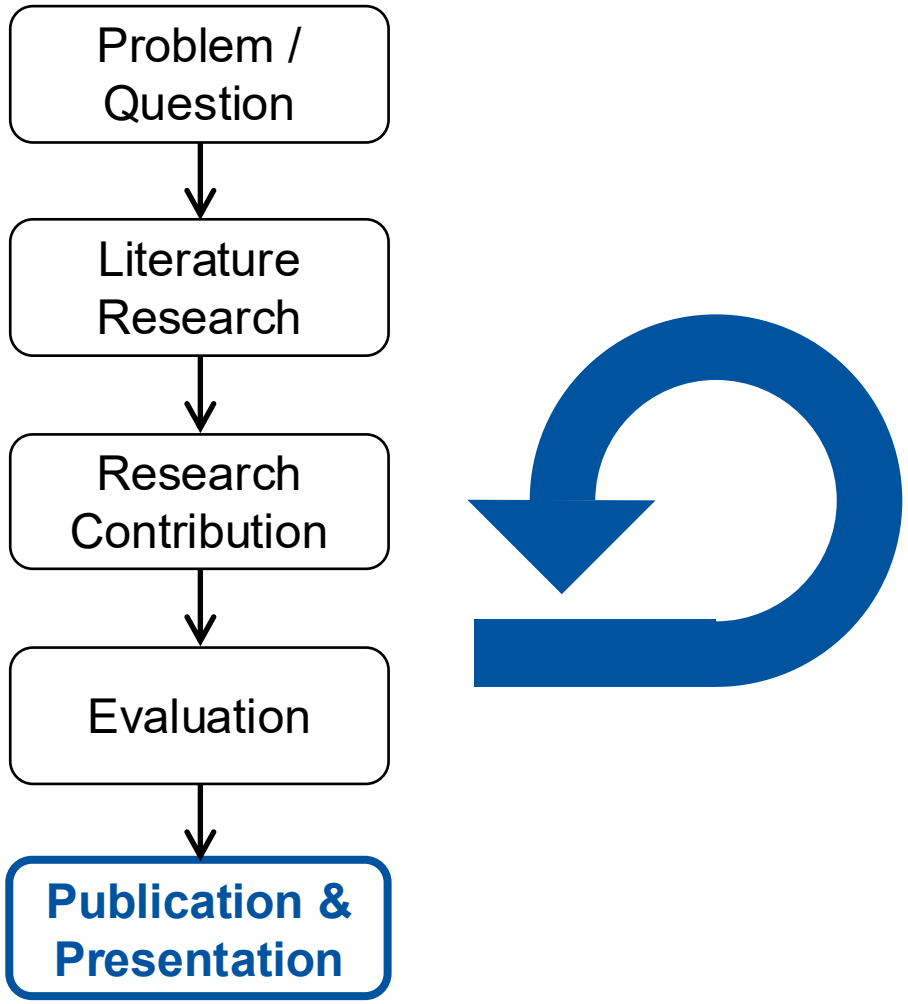
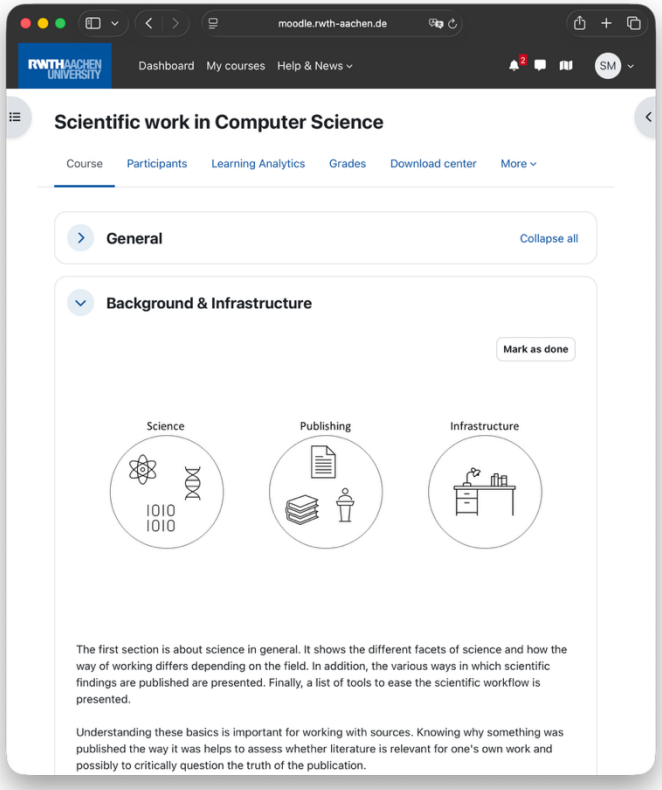
Workshop Content



Based on the RWTH course „Scientific work in Computer Science“



Key Characteristics of Scientific Papers

Scope

- Provides new knowledge
- Contributes to the current state of research
- Focuses on a small, clearly defined area
- Usually presented at conferences
- Follows the journals or seminars formalities

Page Limits

- Ensure efficiency
- Ensure concise and precise formulations
- We exclude the bibliography

we mark seminar specifics orange

Appendix

- Not affected by page limits
- Space for bulky transcripts, source code, experimental data…

Useful Tools

Literature Management

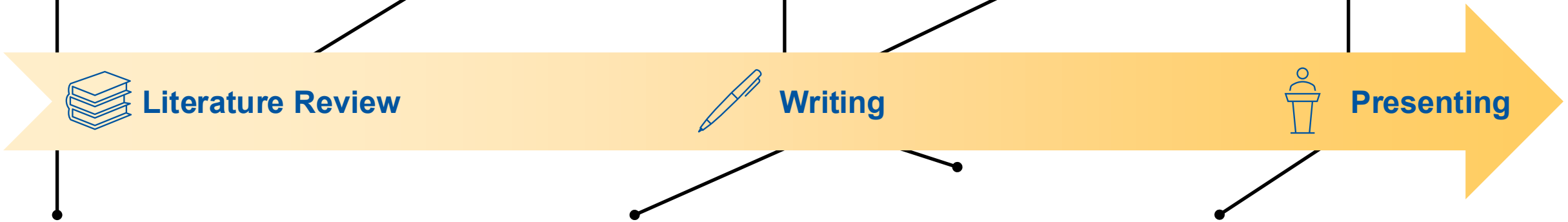
- Zotero organizes and tracks literature
- Add notes and relevance
- Avoid duplicates

Translation Tools

- Look up technical terms
- Use context-aware translations
- Dict.cc, Linguee, DeepL

Visualization

- Improves understanding
- Important for papers & presentations
- Sketches: Draw.io, Lucidchart, Mermaid
- We require PowerPoint for final graphics



Literature Access

- VPN: remote access to licensed literature
- Web of Science

Writing Tools

- ~~MS Word~~
- LaTeX for scientific papers
- Better for formulas, references

Writing Assistants

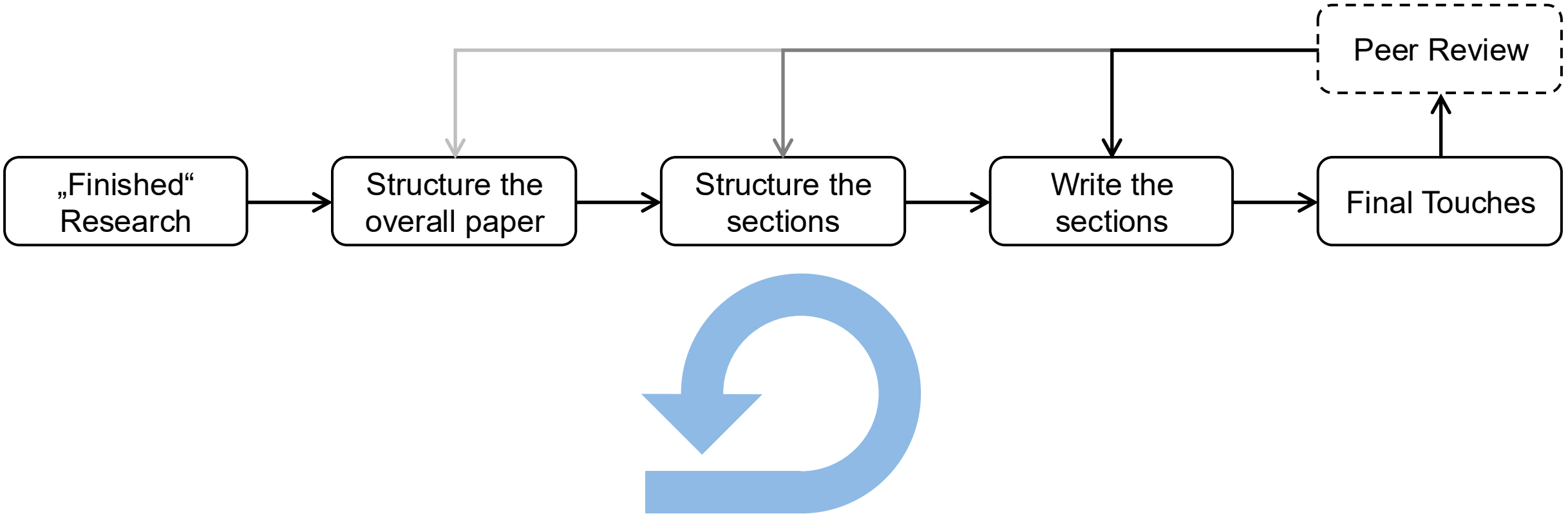
- Enable the editor spellchecker
- Grammarly checks spelling, grammar, tone
- Use LLMs carefully

LLM Usage Guidelines

- Based on principles of good scientific practice
- Allowed but must be transparent and properly disclosed
- Researchers remain fully responsible for content and integrity
- Only natural persons can be listed as authors
- No plagiarism or IP violations permitted
- AI use prohibited in peer review due to confidentiality

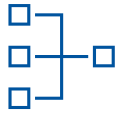
- **Source:** DFG guidelines on generative AI

(Idealized) Writing Procedure



Paper Structure & Narrative Logic

Structure



- Prerequisites finished research / content
- Organize logically, not chronologically
- Adapt the structure to the content

Sections

- Abstract
- Introduction
- *Background*
- Related Work
- *Main Contribution*
- Future Work
- Conclusion

provide meaningful titles

The Common Thread

- Paper ≠ chronological story
- Comparison to novel (1)
  - Object of study = protagonist
  - Background / Related Work = setting
  - Problem / research gap = tension
  - Approach & results = climax
  - Implications = resolution
- Maintain clarity, don‘t leave out missing parts

PRISMA

- Reporting guideline for systematic reviews & meta-analyses
- Improves transparency and completeness

(1) Anna Clemens: https://www.socialsciencespace.com/2018/06/how-to-tell-a-story-in-your-research-paper/

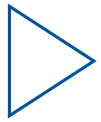
Paper Structure

Abstract

- **Goal:** Readers can quickly assess whether the paper is relevant

- *What's the topic?*
- *What has been done?*
- *What are the results?*
- 50 – 200 words
- See abstract manual

Introduction



- **Goal:** Readers can decide whether to keep reading

- *What is the context of this work?*
- *What is the motivation?*
- *Why is this topic interesting?*
- *What are the results?*
- *How is the paper structured? (only for longer papers)*
- Detail topic, problem, motivation, context, approach and results

Paper Structure

Background

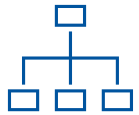
- **Goal:**
  - Readers can follow all content
  - Readers can understand the paper
- Provide necessary prior knowledge
- Assume basic domain knowledge
  - We assume basic knowledge in RSE
- Start from reader's initial level

Related Work

- **Goal:**
  - Readers can understand existing state of research
  - Readers can compare approaches with your contribution
- Present key work of other researchers
- Identify gaps and limitations
- Enable comparison with own work
  - Improvements or extensions
  - New use cases
  - Advantages over prior work
- No fixed length
  - Based on relevant literature
  - Focus on important contributions

Paper Structure: Main Contribution

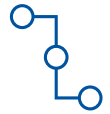
Structure by Argumentation Chain



- Concept
  - Concept of your own approach.
- Realization
  - Practical implementation
- Evaluation
  - Evaluation of the approach
- Methods
  - Methodical approach
- Results
  - Results without interpretation
- Discussion
  - Interpretation and discussion of the results
  - Limitations of the results or approach

you may deviate in the seminar report

Other Structures



- Structure by specificity:
  - general overview → detailed steps
  - useful for different stages
- Structure by research questions:
  - stepwise answering of main and sub-questions
  - useful for common thread
- Structure by examples:
  - start with example
  - formal explanation follows
- Structure by complexity:
  - start with simple case
  - include increasing complexity

Paper Structure

Future Work

- **Goal:** Derive future research directions
- Identify
  - open problems
  - remaining tasks, e.g., evaluations
  - Limitations
- Propose possible improvements

Conclusion

- **Goal:** Summarize core content and key points
- Recap main results and how they were obtained
- State key takeaway of the paper
- Link results back to research question
- Clarify extent of question being answered

Language

General

- Convey knowledge results- and not process-oriented
- Justify everything to make results comprehensible

Adjectives

- Used sparingly for precise descriptions
- Avoid unncessary or decorative or judgmental

Stylistic Devices

- Used only to enhance comprehension
- No devices that leave room for interpretation, e.g., metaphors or rhetorical questions

Compared to older approaches, out method was able to achieve better results in the experiments

Finding a correct path in the graph is NP-hard. The cause of this XY.

Our approach delivers incredible results in the experiments

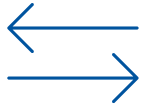
Finding a correct path in the graph is like looking for a needle in a haystack.

Language

Choice of Words

- Express precisely, rationally and objectively
- Keep sentences short
- Avoid vague formulations
- Mark personal opinions

Active vs. Passive



- Predominantly write in active voice
- Actor becomes clear
- Often easier to understand

Our method achieved higher accuracy than previous approaches in the experiments.

The preprocessor converts the source code in the first step.

Our amazing method delivers incredible results and outperforms all others.

In the first step, the source code is converted.

Overcoming Writer‘s Block

Definition

- Temporary inability to write despite intention
- Difficulty starting or continuing text
- Lack of ideas or suitable wording

Possible Solutions

- Planning
  - Use a clear writing plan based on paper structure
  - Set realistic goals
  - Split large chapters over several days
  - Schedule time for proofreading and revisions

- Incremental Writing
  1. Write reasoning first as bullet points
  2. Turn bullet points into first draft
  3. Improve formulations
- Start with easy or motivating chapters
- Writing flow improves after starting

Citing Properly

- Cite all non-original content
- Reasons:
  - avoid plagiarism
  - avoid violating intellectual property
  - separate own from prior work
  - provide credibility and background access
- Two components of citation:
  - in-text citation after quote/ paraphrase
  - bibliography to clearly identify sources
- Format depends on citation style (provided by template)

Citing Properly

Direct Citation

- Word-for-word quotation in quotation marks
- Source given immediately after quote
- Single word omissions marked with `[..]`
- Several omitted words marked with `[...]`
- Additions marked with `[addition]`
- Use rarely in computer science

Indirect Citation

- Content rewritten in own words
- Must not stay close to original wording
- Simple reordering ≠ indirect citation
- Entire paragraph quoted: reference after period
- Only last sentenced quoted: reference before period

"[The] method shows a [...] reduction in the error sum of squares of 5%." [1]

Property XY can reduce the error sum of squares by 5%. [1]

Original: *"Our method shows a significant reduction in the error sum of squares of 5%. This is mainly due to property XY."*

Citing Properly

Sources vs. Footnotes

- Source
  - Information directly used in your work
  - Integrated into your argument or text
  - Must be cited in-text
- Footnote
  - Additional or explanatory information
  - Not directly used in main argument
  - Provides background or clarification
  - Not part of core evidence
- Exception
  - Citation styles like Chicago use footnotes for sources

Et al.

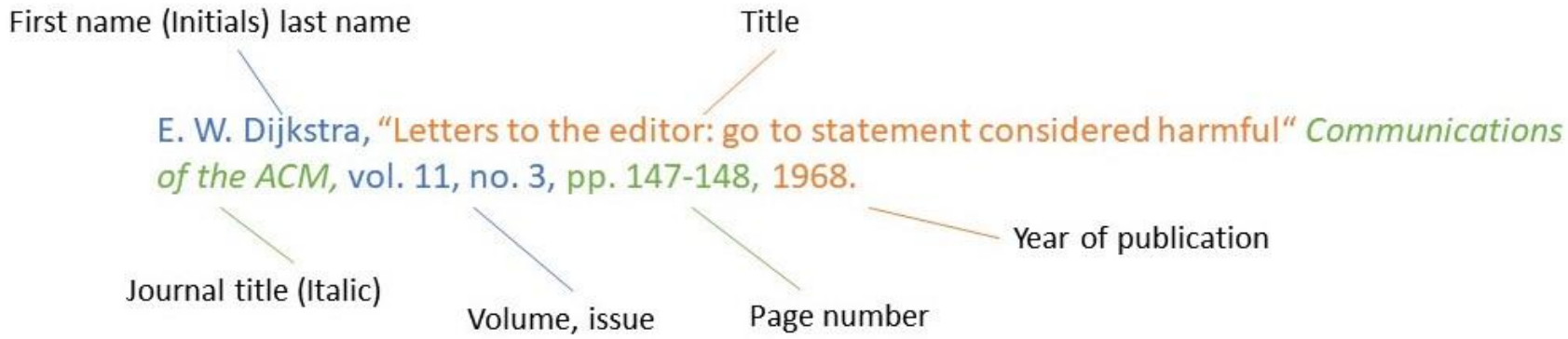
- Many publications have multiple authors
- “et al.” = “and others” (Latin: et alii)
- Used to shorten author lists in text
- Usually applied from 3+ authors (style-dependent)
- Always plural → “et al. describe” (not “describes”)
- Only used in in-text citations
- All authors listed in bibliography

Citing Properly

Citation Styles

- Specified by the template

IEEE



Citing Websites

- Include author, title, and publication date (if available)
- Add URL and access/visit date
- Access date required due to possible changes
- Use organization/company as author if no person listed
- Use HTML page title if no title is given

Further Advice

Use of Visualizations

- Always describe visualizations in the text
- Avoid standalone graphics without context
- Guide reader through what is shown
- Visualization supports the text, not vice versa
- Number all figures consistently
- Refer to figures by number, e.g., Fig. 1

Figure 2 shows the flowchart of the analysis XY. Data is extracted from systems A, B and C.

The visualization below shows a flowchart of the analysis.

Text Formatting

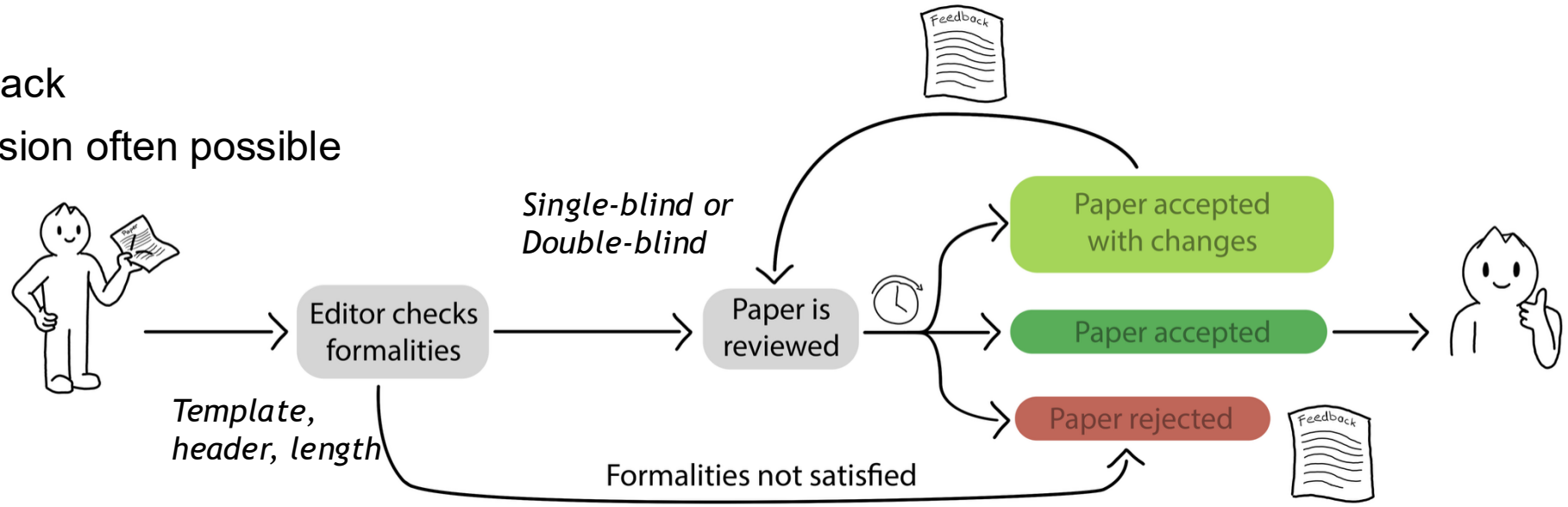
- Bold only for headings
- Italics for:
  - new technical terms
  - foreign words
  - formulas / mathematical symbols
  - book titles (style-dependent)
- Achieve emphasis by rephrasing sentences not bold or italics

The *mean squared error* describes…

Bronze is an alloy of **two** elements.

Peer Review

- Peer review = scientific quality assurance
- Paper evaluated by expert reviewers (peers)
- Decision: acceptance or rejection
- Based on defined review criteria
- Low acceptance rates (≈10–60%)
- Ensures journal quality
- Provides valuable feedback
- Revisions and resubmission often possible



Peer Review

Incorporate Feedback

- Take breaks to evaluate feedback objectively
- Criticism must be reviewed point by point
- Not all reviewer suggestions must be accepted
- Justify decisions when rejecting feedback

Provide Feedback

- Peer review quality depends on reviewers
- Evaluate papers carefully and objectively
- Ensure scientific quality assurance
- Provide constructive feedback to authors
- Be specific (clearly describe issues)
- Be direct (clear, concise wording)
- Stay objective (critique arguments, not authors)
- Use positive phrasing (focus on improvements)
- Consider author perspective
- Use the template

Critique aims to improve the paper, not discourage

Conclusion

Introduction to scientific writing

Key characteristics of scientific papers

Useful tools for different phases

Writing procedure

Paper Structure

Language

Writer‘s Block

Citing Properly

Peer Review