

Uni Scientific Writing Notes

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Contributing

These study materials are heavily based on [professor Charzinski's "Anleitung zum wissenschaftlichen Arbeiten"](#) lecture at HdM Stuttgart.

Found an error or have a suggestion? Please open an issue on GitHub (github.com/pojectfx/uni-sciwriting-notes):



Figure 1: QR code to source repository

If you like the study materials, a GitHub star is always appreciated

License

License



Figure 2: AGPL-3.0 license badge

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Organization

Organization

- ▶ Primarily based on the inverted classroom principle
- ▶ Sent files should not contain metadata on person-specific info (make pseudonymous)
- ▶ Paper must be sent in by 2022-01-09
- ▶ Notes must be sent in by 2022-02-27
- ▶ Paper may be in German or English

Overview

Overview

1. What is the scientific method?
2. Formulating scientific questions
3. Designing experiments
4. Analyzing experiments
5. Planing scientific papers
6. Researching topics and staying up-to-date
 - 6.1 Finding papers → Sci-Hub
 - 6.2 Analyzing papers
 - 6.3 Referencing papers
7. Writing a scientific paper

What is the Scientific Method?

Writing Style

Writing Style

- ▶ Structure should not follow the timeline research, but the semantic structure of the discovery
- ▶ No rhetorical questions
- ▶ No judgmental formulations
- ▶ Sentences should be able to stand on their own; reference people and things by their name, not implicit references
- ▶ Do not use the present tense when referring to past events, even if it is popular in journalism
- ▶ Do not use metaphors which are highly imprecise, even if they are common among technical people
- ▶ “I” should not be used in texts
- ▶ Summaries should be about the effect of the research on the subject, not the author’s view on the subject
- ▶ The “motivation” at the start of the paper should not be the personal factors, but prior pointers

Typical Criteria

Typical Criteria

- ▶ Complexity of the theme
- ▶ Amount of personal research
- ▶ Quality of the content
- ▶ Depth of research
- ▶ Selection of sources
- ▶ Implementation of prior knowledge
- ▶ Structure of the paper
- ▶ Visual style (used fonts, formatting etc.)
- ▶ Quote style (standardized quotes)

Formulating Scientific Questions

Logic and Conclusion

Logic and Conclusion

- ▶ Argumentation
- ▶ Logical conclusions
- ▶ Proofs (i.e. mathematical proofs)
- ▶ Experiments and their design, execution and analysis
- ▶ New analysis is always based on existing knowledge
- ▶ There are different levels of formalism: Argumentation, validation, predicate-based proofs
- ▶ Referencing ideas can be done in an “informal” way (whitepapers etc.), but they must not be the base of any claims!

The Purpose of Writing

The Purpose of Writing

- ▶ Communication is the primary purpose of scientific writing
- ▶ But scientific writing is also a means of analysis
 - ▶ Formulating thesis helps to grasp the connections between arguments
 - ▶ Clear formulation makes it much harder to avoid critical questions
 - ▶ Gaps in analysis and open questions become obvious and lead to new research opportunities
 - ▶ Writing leads to a deeper internal understanding
- ▶ Even if scientific writing is limited to Uni, research methods are always required

The Scientific Thought Model

The Scientific Thought Model

1. Outlook
2. Own research
 - 2.1 Discussion
 - 2.2 Proofs, research, experiments, studies
 - 2.3 Hypothesis, underlying idea
3. Summary of the current state of research/technology
("related work")
4. Sources (own and external)

Quality Assurance

Quality Assurance

- ▶ New ideas should be able to be based on existing works
- ▶ Peer reviews try to check the quality of scientific works and ensures that existing work can serve as a solid base
- ▶ Own share of own work must be made obvious

Scientific Questions

Scientific Questions

- ▶ Formulation a concrete question is required in order to reduce the scope of topics
- ▶ The question doesn't have to be clear in the beginning of the writing process, but must be at the end
- ▶ The focus is always on the question, not the means: “Does the raft algorithm work reliably?” for example would not include/require an implementation of the raft algorithm, so always make the implementation a requirement of the question!
- ▶ The scientific question is not the title of the paper
- ▶ Just like the goals of the research need to be clearly defined, the “non-goals” need to be too!

Experiments

Experiments

- ▶ Gathering of data
- ▶ Hypothesis
 - ▶ Creating the hypothesis
 - ▶ Designing the experiment
 - ▶ Executing the experiment
 - ▶ Testing the hypothesis with the result
 - ▶ Further, refined hypothesis ideas
- ▶ The hypothesis is often “my idea/solution/architecture works”
 - ▶ Experiments support the hypothesis
 - ▶ Paper then describes the current technological state, experiments and results
- ▶ All dependencies and state required to reproduce the experiment must be notes

Methods of Experiments

Methods of Experiments

1. Design
 - 1.1 Matches the scientific question
 - 1.2 Creativity is required
 - 1.3 Viability in time, budget and with available technology
2. Planning
 - 2.1 Prevention of side effects
 - 2.2 No convenience samples
 - 2.3 No unethical experiments
3. Execution
 - 3.1 With proper process
 - 3.2 Proper documentation, including all unexpected incidents
4. Analysis
 - 4.1 Objective analysis
 - 4.2 No suppression of “unwanted” results
5. Interpretation
 - 5.1 Objective interpretation
 - 5.2 Usage of statistics: Is the result even statistically relevant?
 - 5.3 Testing the feedback loop: Has the research question actually been answered?
6. Description: Include all information required to reproduce the

Hypothesis

Hypothesis

- ▶ Verification using proofs
- ▶ Validation based on empirical data
- ▶ Multiple supporting hypothesis can build a theory

Experiment Design

Experiment Design

- ▶ Experiments should produce a result
- ▶ Testing in a specific set of parameters
 - ▶ Searching for optimal parameter combinations
 - ▶ Checking for valid sets
- ▶ Sensitivity analysis
 - ▶ Checking the hypothesis with parameters
 - ▶ Checking if parameters influence results
- ▶ Hypothesis tests: Statistically testing the results of experiments