How to write good (mathematical) papers?

Some ideas and tips

Jessica Kaiser, Philipp Zumstein
Mannheim University Library
29.06.2017
1. Bring the Writing Process to Mind
2. Some Ideas about Good Writing
3. Citations and how to avoid Plagiarism
4. Mathematical Writing
Bring the Writing Process to Mind
Writing process as a model, according to Girgensohn/Sennewald 2005
1. Orientation + Scheduling:
   - Write short summaries of sources
   - Keep a lab diary
   - Describe your evidence

2. Exploitation and Analyzing of data and...

3. Writing a draft

4. Get Feedback, Reviewing and Revising

5. Final Corrections: grammar, orthography, finalize layout

Turn in paper

Writing process as a model, according to Girgensohn/Sennewald 2005
Overall Research Question

1 Orientation + Scheduling: Research, narrow down research question to topics

2 Exploitation and Analyzing of data and literature, develop structure work

3 Writing a draft

3 Quick and Dirty (less regard of style, grammar or citation details)

4 Get Feedback, Reviewing and Revising

5 Final Corrections: grammar, orthography, finalize layout

Turn in paper

Writing process as a model, according to Girgensohn/Sennewald 2005
Overall Research Question

1 Orientation + Scheduling: Research, narrow down research question to topics

2 Exploitation and Analyzing of data and literature, develop structure of work

3 Writing a draft

4 Get Feedback, Reviewing and Revising

3 A Plan:
- Sketch the introduction
- Organize the Body
- Find a Conclusion

5 Final Corrections: grammar, orthography, finalize layout

Turn in paper

Writing process as a model
Regard the Writing Process

• Visualize phases of writing process when scheduling the entire project -> helps you to keep up with your time management

• Set each phase as a „Milestone“ -> A number of smaller todo-packets is easier to cope with than one big one.

• Limit the working time you spent with each phase

• Be aware: Reviewing is a very important phase which requires (almost always) more time and effort than supposed
Regard the Writing Process

- Visualize phases of writing process when scheduling the entire project -> helps you to keep up with your **time management**
- Set each phase as a „Milestone“ - A number of smaller todo-packets is easier to cope with than one big one.
- **Limit the working time** you spent with each phase
- **Be aware**: Reviewing is a very important phase which requires (almost always) more time and effort than supposed

The phases of the writing process are typically not linear at all, but often **recursive**.
**Types of Writers: The Planner (Strategist)**

- Develops structure at first, text is generated out of headwords
- Delays writing out the text in full

<table>
<thead>
<tr>
<th>good</th>
<th>Not so good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeps track of the entire work from the start</td>
<td>Writing lasts longer, being pressed for time is hardly tolerated</td>
</tr>
<tr>
<td>Does not get lost in the subject, no digressions</td>
<td>Less open-minded for new ideas in an early stage of writing already</td>
</tr>
<tr>
<td>Text needs less revisions</td>
<td>Struggles with very complex subjects</td>
</tr>
</tbody>
</table>
Types of Writers: *The Spontaneous*

- Produces text offhanded and kind of associatively
- Structure occurs throughout writing

<table>
<thead>
<tr>
<th>Good</th>
<th>Not so good</th>
</tr>
</thead>
<tbody>
<tr>
<td>No „fear of the blank sheet“</td>
<td>the writers perspective is in focus not the audience</td>
</tr>
<tr>
<td>Many (fresh) ideas, authentic</td>
<td>Text needs extensive revision</td>
</tr>
<tr>
<td>Quick results, although in pressure of time</td>
<td></td>
</tr>
</tbody>
</table>
Types of Writers: *The Editor*

- Perfectionist
- Structure and „Core“ of a text are a result of correcting over and over

<table>
<thead>
<tr>
<th>Good</th>
<th>Not so good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produces Text easily</td>
<td>Endless revises and re-revises</td>
</tr>
<tr>
<td>Focus on the reader from an early state of work</td>
<td>Entraps in bits and bobs</td>
</tr>
<tr>
<td>Appropriate, elaborate Style</td>
<td>A lot of frustration and less „working flow“</td>
</tr>
</tbody>
</table>
Another Model of Writing Process

L2-Writing based on Hayes & Flower 1980 Structure of the writing model Grießhaber 2005
Another Model of Writing Process

Considers more of the surrounding conditions of scientific writing..
Scientific English as a non-native Speaker

Some Tips

| **Word order subject-verb-object** is only rarely altered, keep subject and verb close to each other |
| **Write out all verb forms – avoid it’s, doesn’t** |
| **Avoid starting sentences with And, But, Because** |
| **Avoid ending sentences with too, also, though or yet** |
| **Signaling action: start a sentence with a gerund („-ing“) and a subject** |
| **Starting a sentence with a gerund is a different story** |
| **Use more verbs, less nouns** |
| **Common error: Compared with vs compares to. Similar order of things are compared with one another, different orders of things are compared to one another** |

......
Against Procrastination - Your Personal Task Environment

- *Morning person* or *night owl*? Schedule Creative Writing on your favorite time of the day.

- Use the not so creative hours for literature research, formal corrections etc.

- Set a number of „Milestones“, make „down-to earth“ plans about your every day writing pensum. How planned are your days? Due of important private appointments? Schedule leisure time and rest!

- Arrange your writing zone (at home? In the library? In the café?) free from distractions.
Against Procrastination - Your Personal Task Environment

• Get unplugged! 😊 Grant a rest to your mobile phone and avoid social networks

Source: https://www.flickr.com/photos/birgerking/6875893248
by Hunter Lang

• Choose flow instead of distraction
• Grant a rest to your mobile phone and get unplugged
Some Ideas about Good Writing
Some Ideas about Good Writing

Even brilliant thoughts are only impressive if they can be easily get by your readers instead of being hidden in a text-jungle.

The probability of writing a sentence perfectly the first time is vanishingly small

Revising and polishing a draft is essential and frequently the difference between good and less good writing!
Some Ideas about Good Writing

Difficulties of Rewriting
You will hardly notice ambiguities and explanatory gaps
You know what you meant to say and you understand the omitted steps

Lay the manuscript aside for a while
Try to read it as your grandmother or your rubber duck or (…)
ask yourself: Have I been told yet what this concept means? - Has the logic of this step been demonstrated?

The ability to anticipate the audience level of understanding at each point is a very good skill:

Good writing is good teaching
Some Ideas about Good Writing

Get Feedback! If your colleagues find something unclear, don’t argue with them - as unclarity detectors, readers are never wrong.

The word processing program is very virtuous to make cosmetic changes but mostly not an adequate restructuring tool!
Some Tips for Writing Coherent Texts

To guide the audience through the text use *signposts*:

- **Headings and subheadings** tell what the readers are going to meet in this section
- **Summary sentences** (e.g. the final sentence of a section)
- **Words for Transition**: however, similarly, furthermore, ....
- **Use announcements** and **back references** (............)

Check each section/paragraph
How does it relate to the overall research question?
Which question of detail should be answered in it?

Start every chapter with referring to the overall question or the preceding chapter

End every chapter with a summary or a transition to the next chapter
Matters of Style

Omit needless words

Good writing is concise. A sentence should contain no unnecessary words / a paragraph no unnecessary sentence. Try to spend 15 Minutes each day omitting needless words!

Write short simple sentences

Make paragraphs

one idea per one paragraph
first sentence of every paragraph is the „topic“ sentence“ and shows the reader what the paragraph is going to be about
Matters of Style

Use Repetition and Parallel Construction
Don’t substitute synonyms for recurring words and vary the sentence structure, this can be confusing
Repetition and Parallel Constructions bring clarity

Jargon
the specialized vocabulary of your discipline functions as a short-cut,
it is more precise or free of surplus meanings than any natural language equivalent. If it is not, choose natural language
Matters of Style

Voice and self-reference
in the past: majority of academic writing was in the passive voice, the authors referred to themselves in the third person
This experiment was designed by the authors to test..
today: use the active voice (more direct, shorter, clearer), do not refer to yourself as we, keep self-reference to a minimum

Avoid metacommments on the writing
do not divert the readers attention away from the topic

Avoid language bias
No generic use of man, he, his, him to refer to both sexes
3 Citations and how to avoid plagiarism
Standing on the shoulders of giants

“If I have seen further, it is by standing on the shoulders of giants.” Newton 1676

Always state on who’s shoulders you’re standing!

Encyclopedic manuscript containing allegorical and medical drawings
South Germany, ca. 1410 Rosenwald 4 (image 15)
http://lcweb2.loc.gov/cgi-bin/ampage?collId=rbc3&fileName=rbc0001_2006rosen0004page.db&recNum=14
Plagiarism

Plagiarism = using someone else’s work without attribution

Plagiarism is the one thing you absolutely must avoid!

Graphic by „user8“ on http://de.guttenplag.wikia.com/wiki/Datei:Thum b_xx1.png retrieved on 2017-04-03
Copy and paste w/o attribution

• Doe (2008), p. 18:
  • 80% of respondents were tempted to procrastinate by using Facebook, hence we predict a similar pattern for Twitter usage.

• You:
  • 80% of respondents were tempted to procrastinate by using Facebook, hence we predict a similar pattern for Twitter usage.
Attribute everything!

- Doe (2008), p. 18:
  - 80% of respondents were tempted to procrastinate by using Facebook, hence we predict a similar pattern for Twitter usage.

- You:
  - Based on the findings by Doe, that “80% of respondents were tempted to procrastinate by using Facebook” (Doe 2008, p.18), we strongly expect the same correlation in using Twitter.
Different forms of plagiarism

- Translation without attribution is still plagiarism
- Self-plagiarism
- Copy and paste text w/o attribution
- Copy and paste pictures w/o attribution
- Copy and paste tables w/o attribution
Common Knowledge

- No attribution is needed for common knowledge
- But what is common knowledge in your area?
  - Pythagorean Theorem
  - $E = mc^2$
  - The fact that the number e is irrational.
  - Knuth’s soundex algorithm
  - Schwartz-Zippel Theorem
  - ...?
Second-hand quote

• Doe (2008), p. 18:
  80% of respondents were tempted to procrastinate by using Facebook, hence we predict a similar pattern for Twitter usage.

• Smith (2010), p. 3:
  The findings by Doe (2008, p.18) shows that “80% of respondents were tempted to procrastinate by using Facebook”.

• You:
  “80% of respondents were tempted to procrastinate by using Facebook” (Smith 2010, p. 3) *(Doe 2008, p. 18)*

• But if Doe 2008 is inaccessible, then it is possible to quote:
  “80% of respondents were tempted to procrastinate by using Facebook” *(Doe 2008, p. 18, as quoted by Smith 2010, p. 3)*
4 Mathematical Writing
Writing only mathematical symbols

\[ x \in \mathbb{R} \quad x > 0 \quad x > 3 \implies x^2 > 9 \]

\[ \forall x \exists y \quad x \geq 0 \implies y^2 = x \]

\[ x \in \mathbb{R} \]
\[ x^2 - 16x + 63 = 0 \]
\[ x = 7 \quad x = 9 \]

• Hard to read, also the math is easy.
• How are the different lines/equations connected?
Writing Mathematics in Sentences

• Write in full sentences
• Include mathematical formulas in these sentences
• Include punctuation in mathematical formulas
• Try to not start a sentence with a symbol
• Examples:
  – Let $x$ be a real number.
  – Assume $x > 0$.
  – If $x > 3$, then $x^2 > 9$. 
For each \( x \in X \) we have the decomposition \( x = \xi + \lambda \), with \( \xi \in \Xi \) and \( \lambda \in \Lambda \); accordingly, we define the function \( P: X \to \Xi, \quad x \mapsto \xi \), which extracts the first component of \( x \).
\[ x \in X \]
\[ x = \xi + \lambda \]
\[ \xi \in \mathbb{E} \]
\[ \lambda \in \Lambda \]
\[ P : X \rightarrow \mathbb{E}, x \mapsto \xi \]

\[ x \]
Writing Definitions

“A definition requires a pause, to give the reader time to absorb it. This may be achieved by giving the definition twice, first with words then with symbols (or vice-versa), by using two different formulations, or by supporting the definition with an example.” (Vivaldi 2014, p. 104ff)
Example: Writing Definitions

For each $x \in X$ we have the decomposition $x = \xi + \lambda$, with $\xi \in \Xi$ and $\lambda \in \Lambda$; accordingly, we define the function $P : X \to \Xi$, $x \mapsto \xi$, which extracts the first component of $x$. 
Example: Writing Definitions

The arrow notation is defined for all natural numbers $a, b \geq 1, n \geq 0$ by

$$a \uparrow^n b = \begin{cases} 
a, & \text{if } b = 1; 
\a \cdot b, & \text{if } n = 0; 
\a \uparrow^{n-1} (a \uparrow^n (b - 1)), & \text{else.}
\end{cases}$$

Examples:

$3 \uparrow 1 = 3$
$3 \uparrow 2 = 3 \cdot (3 \uparrow 1) = 3 \cdot 3$
$3 \uparrow\uparrow 2 = 3 \uparrow (3 \uparrow\uparrow 1) = 3 \uparrow 3$
$3 \uparrow\uparrow\uparrow 2 = 3 \uparrow\uparrow (3 \uparrow\uparrow\uparrow 1) = 3 \uparrow\uparrow 3$
$3 \uparrow\uparrow\uparrow\uparrow 2 = 3 \uparrow\uparrow\uparrow (3 \uparrow\uparrow\uparrow\uparrow 1) = 3 \uparrow\uparrow\uparrow 3$
$3 \uparrow\uparrow\uparrow\uparrow 3 = 3 \uparrow\uparrow (3 \uparrow\uparrow\uparrow 2) = 3 \uparrow\uparrow 3 \uparrow 3$
The Art of Formulating Theorems

Schwartz-Zippel Theorem: Let $F$ be a finite field of size $q$, let $n \geq 1$, and let $P \in F[x_1, x_2, \ldots, x_n]$ be a polynomial of degree at most $d < q$. If $P$ is non-zero then the number of zeros of $P$ in $F^n$ is at most $dq^{n-1}$. (Or let $S$ be a finite subset of an arbitrary field $F$, then $P$ has at most $d|S|^{n-1}$ zeros in $S^n \subset F^n$.)

Formulation from a Ph.D. student
The Art of Formulating Theorems

Schwartz-Zippel Theorem: Let $\mathcal{F}$ be a field, let $d$ be a natural number, and let $S$ be a subset of $\mathcal{F}$. Then for every non-zero polynomial $f \in \mathcal{F}[x_1, \ldots, x_n]$ of degree $d$, the number of $n$-tuples $(r_1, \ldots, r_n) \in S^n$ with $f(r_1, \ldots, r_n) = 0$ is at most $d|S|^{n-1}$. In other words, if $r_1, \ldots, r_n \in S$ are chosen independently and uniformly at random, then the probability of $f(r_1, \ldots, r_n) = 0$ is at most $\frac{d}{|S|}$.

Formulation by Prof. Matoušek
The Art of Formulating Theorems

• Explain first notation (linear reading order, reader does not have to go forth and back to understand)
• Theorem is understandable independently, i.e. everything which is important is part of the theorem
• Choose variable names which are meaningful, e.g. d for degree, S for subset
• Accurate (e.g. choose indep.+uniform at random)
• Only a few sentences
Further Resources: Books

• in Central Lending Library: 2014 A 4510 (see 3D plan)
• https://doi.org/10.1007/978-1-4471-6527-9

• in A5 library branch: SB 820 T876 (see 3D plan)
• http://www.ems-ph.org/books/show_pdf.php?proj_nr=34&vol=01

• https://doi.org/10.1137/1.9780898719550

• https://arxiv.org/abs/1612.04888
Further Resources: Books

Wallwork, Adrian (2016): English for writing research papers. 2\textsuperscript{nd} edition.
- in Central Lending Library: 2017 A 0861 (see 3D plan)
- 1\textsuperscript{st} edition: https://doi.org/10.1007/978-1-4419-7922-3

Glasman-Deal, Hilary (2013): Science research writing: for non-native speakers of English
- in Central Lending Library: 2015 A 1726 (see 3D plan)

Booth, Colomb, Williams (2016): The Craft of Research. 4\textsuperscript{th} edition.
- 4\textsuperscript{th} edition is ordered for the library
- 3\textsuperscript{rd} edition (2008): 2008 A 3203, 2008 AU 0494
Further Resources: Others

Lübbecke, Marco (2014): How to write a Paper [Blog Post]
https://mluebbecke.wordpress.com/2014/11/21/how-to-write-a-paper/

Questions? Comments?

Jessica Kaiser (Academic Writing Consultancy)
jessica.kaiser@bib.uni-mannheim.de

Philipp Zumstein (Subject Librarian for Mathematics and Computer Science, Mannheim University Library)
philipp.zumstein@bib.uni-mannheim.de
Image Credits

- [https://pixabay.com/de/home-office-arbeitsplatz-b%C3%BCro-336378/](https://pixabay.com/de/home-office-arbeitsplatz-b%C3%BCro-336378/) (CC0)
- *Writing process as a model, according to Girgensohn/Sennewald 2005*
- L2-writing based on Hayes & Flower 1980 of the writing model Grießhaber 2005
- Encyclopedic manuscript containing allegorical and medical drawings South Germany, ca. 1410 [Rosenwald 4](http://lcweb2.loc.gov/cgi-bin/ampage?collId=rbc3&fileName=rbc0001_2006rosen0004page.db&recNum=14) (image 15)