

Guidelines for writing an MSc thesis

The “storytelling” of thesis writing: Step-by-step guidance

Henriette Lyng Røder and Sylvester Holt

Department of Food Science
University of Copenhagen



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Introduction

Writing is often taught as a secondary skill during university studies, and during courses, e.g., laboratory reports, are often put together just days before the deadline. It is also widely acknowledged that crafting a thesis can be a difficult task for many students, as scientific writing can be challenging, even for experienced researchers. Therefore, it is better to

address the thesis writing itself as a serious challenge and start early in the project flow. The primary objective when engaging in a hypothesis-driven project is to present the successful execution of an experiment, with the ultimate goal of presenting a scientific result. However, due to the limited time, the goal is primarily to show that you can carry out independent work, which is the key to a good thesis. This involves a rigorous process of planning, executing, and analyzing data to produce reliable and reproducible results. Therefore, a thesis project requires a high level of commitment and attention to detail to ensure its successful completion and academic recognition. The goal is to provide a step-by-step guide to assist with thesis writing. We recognize that there are no shortcuts around writing but hope these guidelines will assist the process where thesis work aims *to demonstrate the successful completion of a practical experiment within a limited time frame, leading to scientifically significant conclusions*. Further inspiration can also be found in some of the numerous books and papers about scientific writing (Murray, 2011; Rienecker & Stray Jørgensen, 2022; Rienecker et al., 2006; Silvia, 2019).

Start writing as soon as possible!

Many people mistakenly believe that they must have their results before they can begin writing their theory. This is a common misconception. Before you start, you and your supervisor must formulate a short text to describe the research topic for the ‘statement of dissertation’ in your thesis contract. You should describe the research topic and the problem in broad terms. The very first part of the thesis may also be a brainstorming session with your supervisor to focus on the project. When you start your work, you can only deviate slightly from the initial research topic. To excel in your research project, it is advisable to start reading research papers on your topic of interest right from the beginning. However, reading alone is not sufficient. To produce a high-quality thesis in just one semester, we suggest you begin outlining your theory and literature review with your supervisor as soon as possible after starting the project. Some students will start with the methods and methods section to burst the bubble. Whatever works best is up to you.

Outlining your theory/literature review

It is essential to identify the central hypothesis in the problem definition. The central hypothesis helps the reader understand the topic in detail. For instance, if your project is about untargeted analysis of a food product, someone must have thought about why this type of analysis is interesting for this specific product. For example, the central hypothesis could be "untargeted lipidomics of cheddar cheese will reveal overall tendencies of matrix evolution during cheese ripening".

Take a Step Back Before You Start

Take a step back and consider what the reader needs to follow and understand your results and discussion. Your job is to discuss the literature that inspired this research question. *What has been done before?* The most common mistake is to write an introduction that does not relate closely to the research problem. The theory section of your thesis is not a mere summary of what you have learned during previous courses. Rather, it should be a text that presents the most significant studies that shed light on the specific research question of your thesis. If you have important findings from your results that need additional introduction, you should integrate them into your theory section.

Get an Overview of the Relevant Literature

We recommend consulting the guide for searching for literature available from the University Library (<https://kub.ku.dk/english/libraries/frederiksberg/guidance/search/>). If you are in doubt, ask the librarians; they will be more than happy to help. You have access to these tools when you are at the campus library or connected through the University network. A tip is to look for recent reviews and papers on the topic that has been published within the research group. The original research published within your research group can help you to understand the rationale behind your project, methods, and more, and should not be ignored. You can then identify other original research papers in the topic through Web of Science, where you have the possibility of linking to other papers directly through the

references. Also, do not underestimate a Google search - it can help you with many questions. For using a specific reference tool in your thesis, please align yourself with your supervisor. This is especially important if you want to send a draft and have to send your library created with the reference tool to your supervisor.

Make a Writing Schedule

Students often find that one of the main obstacles to writing is to get to do the actual writing. Typically, you will not write your theory section in the first few weeks because you have other obligations (student jobs, experiments, etc.). We encourage you to make ‘serial writing’ as described by Murray (2011), where you break down the writing into sizeable blocks. Creating a weekly writing schedule and dedicating specific time slots to it is crucial if you aim to stay ahead in your writing. This and other obstacles are addressed in Silvia (2019).

Pitfalls in writing

Below are some of the typical problems in writing styles. However, remember, just start writing! You can go back and revise your text later when you have a better understanding of how the structure should be, and keep a critical eye on what you have written.

Imprecise, Generic, or Unclear Language

The specific style of scientific writing is something you will have to learn. Your statements have to be precise and to the point without being biased toward a certain direction. If for example, you write that $1 + 6$ is more than two, it is correct but not precise. Do not write generic or broad sentences, especially without being able to have reliable references (Bassham, 2023). This is not to say that you should spend hours perfecting the language of every sentence. As long as the meaning of the sentence is clear, you can move along.

Biased Language and Critical Thinking

When you write your thesis, you need to understand the scientific literature and be critical about the sources. It is very easy to get carried away with what looks like impressive papers, that contain hidden flaws. Sometimes you need to be an expert in the field to spot experimental or statistical mistakes. Some examples include lack of controls, spurious correlations, correlation \neq causation, incorrect normalization. If you feel in doubt about a research paper and have a specific paper, your supervisor will likely be more than happy to discuss it with you. Based on your own interesting results, you may either claim too broadly or, on the other hand, not recognize the full importance of your results. The central point is learning critical thinking, a skill that takes practice to master. To read more about this, we recommend *Critical Thinking: A students guide* by Bassham (2023).

Storytelling in thesis writing

So, how do you get started? A good first step could be to view the process as a form of storytelling as it is known from a book or movie. This can be a good frame of reference to remember when deciding on a place to start. Simply put, you can't start a story without an idea or plan. An example could be the classic thriller plot structure (The hook, crisis with rising action curve often based on solving a dilemma, climax – solution to the dilemma, and falling action curve). This can, to some degree, also suit academic texts that also seek to answer a research question (the dilemma) or verify a hypothesis. However, you should always go for clarity and, of course, not, as in a book, prolong a revelation purposely to “heighten the suspense”. The product here is driven by the research questions and hypotheses, experimental parts, and findings in results that unfold the story and the narrative. So, by keeping to this analogy, we will try to go through the steps.

Remember the storyline: Stay on the path!

When writing the “story”, it's important to keep the following points in mind, especially at the start. Firstly, take the time to introduce the main

characters, which, in the case of research writing, are the research questions or hypotheses. It's crucial to describe them in a way that is relevant and gives the reader all the information they need to understand the story. Introducing a completely unrelated character would only confuse the reader. Therefore, it's important to always focus on why the reader should care about what they're reading. This method can help you stay focused and ultimately save time when writing a thesis. Another important question to ask yourself while writing is whether what you're writing helps to frame the research question and whether there is a clear path through the story. Ask yourself why this information is needed and whether your examples are adequately supported. Use these questions as your little test throughout the writing process to help you write a clear and concise thesis. It can also help using text templates as in chapter 5.2 of Jørgensen and Reinecker (2015) and fill them out to guide the structure and discussion with your supervisor (the book can be found both in Danish and English).

Scientific Writing Style

Another important part to consider before writing. The main point is to adopt a clear and concise writing style to ensure the thesis is easy to read and comprehend. Support for the academic writing style can be found in many places and the publisher, Nature, has a guide with examples of formulations (Doumont, 2010). However main points to remember: i) stick to the storyline and create a logical framework around it, ii) be clear and remember to explain why iii) be aware of the literature that already exists in relation to your story and of course reference it, iv) ensure your references are current and relevant to the story.

A possible outline of the “storytelling” of a thesis

With this in mind, we can start discussing the parts that make up the storytelling part of a thesis. See also Figure 1 in Singh and Mayer (2014) which has a demonstration of the components often found in a thesis and reflection for more inspiration.

Frontpage

Apart from the mandatory sheet with details, a cover page of the project should include the title, author names, student numbers, project type, size of project - ECTS points, supervisor's name, location, and date. A nice image or figure is of course a fine addition here to set the stage already, like the front cover of a good book sets the stage for what is going to happen.

Preface

It is important to start the thesis with a preface that includes the location, and acknowledgments for those who have assisted you with guidance, supervision, or gave comments is good practice to include. It is always great to show gratitude for the support and guidance that was given along the way. This can also be placed at the end of the thesis.

List of Abbreviations

All abbreviations must be defined when first used. A list of uncommon abbreviations may be included at the beginning of the report.

Table of Contents

It is important to begin setting up the table of contents as soon as possible, after formulating a hypothesis for your thesis. This initial step of setting up the plot line through an index can provide a solid starting point for the rest of your work. Creating an index early on can help you break down the thesis writing process into smaller steps, making progress more manageable.

Abstract

The abstract is not your typical storytelling section if compared to a summary in a book. It must provide an overview of the whole story, including the conclusion. The thesis abstract is a brief and informative summary that outlines the research question, purpose, methodology, key findings, and conclusion of the project. The main goal of the abstract is

to provide the reader with a clear understanding of what the thesis covers and what they can expect to gain from reading it. Therefore, writing an abstract that accurately represents the thesis content and sets the right expectations for the reader is crucial. Think of it as a teasing commercial meant to inspire the reader to read the full story to find out exactly how the conclusion was reached. See Table 1 for a classical way to build an abstract.

Table 1. Structure of an abstract. Compiled from Nagda (2013), which also includes common mistakes.

Background	This is an introduction to what your topic is about.
Aim of research	Statement about the purpose of the work. Maybe also address why other studies have not tackled similar research questions.
Method used	How were the research questions tackled?
Findings/results	What research results were found?
Conclusion	Key findings through the project.

1. Introduction

The introduction should provide an easily understandable insight into the structure and style of the thesis and help create a compelling story. Additionally, the introduction can include possible limitations and a map of the following sections to guide the reader.

To make the thesis compelling and informative, it is essential to begin with a clear and concise introduction that effectively outlines the project and its defined problems. See Table 2 for an outline example of an introduction. It is also important to break down the overall objective into sub-objectives or research goals for a more accessible design and conclusion drawing. The introduction should focus on answering key questions in context to the aim e.g., what is already known about the topic, what knowledge gaps still exist, and why this information is important.

Table 2. Introduction, Getting Started. Based on guidelines by Nature publishing (Doumont, 2010).

Start	A claim or claims that brings readers on board with the text. Provide the context to orient the readers into the research behind your story while highlighting the importance.
Problematization	Presentation of the problem that requires investigation in this story.
Reason	It is important to highlight the gap between what the scientific community currently possesses and what it desires.
Research question or hypothesis	Make clear what the most important issue is. An explanation of why knowing the answer to this issue will be an important element in starting to solve the problem. The research question or hypothesis around this problem is the core of the entire thesis and will become the focus of everything that will follow.
Preview	The remainder of the intro should describe what kind of answer this text will deliver to the research question and optional outline. If the text has a complex structure, it can be helpful to provide an orientation as an outline for the reader. For instance, if the text includes parallel storylines that converge in the Results section, you can mention this and provide an outline to guide the reader.

2. Hypotheses or Research Questions

Every story has a plot, and similarly, every thesis needs to have a clearly defined research question or hypothesis that the project revolves around. It can be challenging to establish a research question or hypothesis and, in such cases, seeking guidance from the supervisor can be beneficial. It is important to focus on the problem and formulate a good hypothesis or research question as both the writing and the project itself will be centered around it. Although your supervisor may have a hypothesis in mind, it is essential to develop it together. A well-defined hypothesis is vital for any research project and should clearly state the objective and the expected

outcome of the research. This is the accelerator of your thriller plot line. The unexpected crime that sets into motion all other events that unfold in the story. Your project aims to take this hypothesis and try to disprove it. If the project takes a different direction, you can add a second hypothesis, but this should not be done without adequate consideration. This is written here in the thesis structure but is a step that needs to be clear from the very beginning when starting. *Should be formulated as soon as possible when you start.*

3. Theory or Background (literature review)

The initial parts of any story set the stage for us to understand what the author intends to tell. Therefore, it is important to stay focused on what is needed to understand the story and how it relates to the background that was presented in the introduction. For a research project, the theoretical background should be relevant and focused on the research question at hand. This can be done by linking back to the introduction to clearly show the storyline. Chapters and paragraphs should have self-explanatory headings and not require further explanation. However, a brief introduction outlining what will be covered and the reason for it can be included to support the reader's focus. It is also possible to conclude with a summary of the most important information in the sections. In any case, this section should still follow the line of the story to ensure that everything is connected. See Table 3 for considerations to take into account when writing the theory.

The theory is based on the findings of other researchers and serves as a description of the current state-of-the-art. Maintaining a critical attitude towards the data and papers is important for the storyline. If possible, use only primary literature. Furthermore, understanding the difference between paraphrasing theories, using citations, and correctly referring to actual information and theory is crucial.

Table 3. Theory or Background – a literature review to understand the importance of the story. Based on publicly available resources. (Labaree; Salovaara, 2020)

<p>Identification of knowledge needed to answer the research question or hypothesis (before writing)</p>	<p>It is important to reflect on the research question and the types of knowledge required to start answering it. This reflection can be based on common sense. For instance, when dealing with problems about green solutions, it is possible to approach them by either benchmarking existing solutions or analyzing the requirements and opportunities that the problem's context poses on the solution. The selection of what needs to be included should depend on appropriateness.</p>
<p>Review of the knowledge, each one in its own section here (in background)</p>	<p>For each perspective or area found above, there should be a corresponding subsection. These subsections will provide information on what is currently known about the Research Question from that viewpoint. Giving a new interpretation based on the material to provide the relevant theory, giving the basis for the hypothesis. Each subsection will conclude with a summarizing paragraph to support the reader on how the question can be better understood in light of the information provided. This further establishes the need for this particular research and legitimizes its importance.</p>

4. Experimental design / Research design

An overview of the experimental part of the story. A figure can provide a clear and concise overview of very complex setups and is often worth investing some time into. It can significantly enhance the reader's understanding before delving into the experimental work. Including relevant variables and parameters is equally important to ensure that the reader can easily comprehend the experimental design. This will enable

the reader to easily follow the experimental work and provide a better understanding of the results obtained. Furthermore, this can also be a way to have a roadmap for yourself to guide your writing.

5. Materials and Methods

Getting the facts and details down in order to understand how the results arrived is a very important part of the scientific story. To ensure the reproducibility of your experiments, it is crucial to provide a detailed list of all the materials, including ingredients, chemicals, a list of microbial strains, and equipment used, along with their respective producers and land of origin. Additionally, a well-written introduction to your experimental work is essential and should include a description of the statistical models used in data processing. It is important to ensure that your description of the experimental work is clear and concise, to enable others to replicate the experiment successfully. Including figures or photos of the experimental set-up is also highly recommended, as it can assist the reader significantly in understanding the experiments you have conducted. See Table 4 for some highlights to include in the methods.

Table 4. Methods. Based on publicly available resources. (Labaree; Salovaara, 2020)

Methods	Description of the methods used to answer the research question. Remember to cite and present if the methods have been used before and if adjustments have been made. Remember to state what the methods were used for in the beginning. The methods must be so detailed that they can be reproduced without any other sources.
Data analysis	This section should provide a description of how the data was analyzed. In certain cases, this section may also be part of the Results section where it is mixed with the findings. This is especially true if the analysis cannot be explained without presenting the data. This scenario may be applicable in exploratory design projects where different stages require decision-making and reflection on why the decisions were taken the way they were.

6. Results

One could argue whether the results or the discussion would be the climax of the story, but for sure the results are the ones building up to the climax. It is important to present the obtained results clearly and consistently, along with the different research parameters so you can follow the way the work went and the reasoning behind and the relation to the question. You should carefully consider the best way to present it, whether through figures or tables, and prepare for the discussion and conclusion. If possible, statistical calculations should be performed on the results, and along with that, it is crucial to also report the appropriate significance values. Like other parts, it is a good idea to include photos or figures of the samples or products to provide a visual representation for the reader. The faculty of Science at KU also offers additional support for data analysis where students can go and ask questions.

a. Figures

Numbering all figures in your thesis is crucial. Each figure should include a concise explanatory text that is comprehensible independently of the report. While referencing facts in the text is acceptable in some cases, it is advisable to minimize such instances. The legend accompanying the figure must explicitly state its objective and elucidate the meaning of any symbols or abbreviations employed. Position the explanatory text below the figure. It is essential to consistently refer to the figure number when discussing it in the text and ensure proper referencing. Utilizing the cross-reference tool in Word or similar software is recommended for numbering and referencing figures.

b. Tables

When constructing tables, assign them a number along with a concise explanatory text that can stand alone and be comprehensible independently of the report. While referencing the text is permissible in certain instances, the table text should explicitly convey the illustration and provide clear explanations for any symbols or abbreviations utilized. Position the explanatory text *above* the table. Ensure consistent reference to the table number in the text. Use the cross-reference tool in Word to assign numbers and make references to tables.

7. Discussion

Academic writing has included an additional step compared to traditional story writing, a discussion. Here, the aim is to lift the story to a meta-level reflection to provide the reader with an understanding of the wider perspective of the research (see the guide for Organizing Academic Research Papers by Labaree ; <https://library.sacredheart.edu/c.php?g=29803&p=185920>). During the discussion, the collected experimental data is analyzed in depth, examining the methods used to gather it and evaluating the accuracy of the results. A good way to start a discussion is to clearly state the most important findings of the thesis. Then you should guide the reader, with detailed discussion in separate paragraphs. This critical evaluation is essential in determining the overall validity of the study. Some students may tend to ignore the limitations of the study and your experimental design to make the study look “perfect”. It is better to discuss these in your thesis, because it shows that you understand your research. On the other hand, some students are overly critical and do not see the full extent of the scientific advancement that they have brought to the field. Importantly, this is your chance to discuss freely compared to the results section. Your data needs to be compared to other findings in similar studies, with particular attention paid to the theoretical underpinnings of the research. By doing so, researchers can better understand the context of their results and the implications they hold for future research. To get a complete picture of the research being conducted, source references are cited and included in the discussion. This allows the reader to trace the origins of the data and assess its reliability.

Table 4. Discussion. Based on Lewis et al. (2021).

Return to the beginning	Introduction to the discussion by repeating the research questions and objectives to remind the reader of the overall purpose of the project in case they forgot during the previous parts.
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Main findings	Here is the brief summary of the main point found for the research questions to start off the discussion.
Expansion	After conducting the study, it is important to include statements to acknowledge and discuss the implications of the findings. Here, it is good to focus both on the strengths and limitations of this work and beyond. These statements should identify the potential impact of the study's results and provide further context for interpreting the data. Here, it is important to find and cite relevant papers to set the story into a broader context to see where these findings fit in and their relevance.

8. Conclusion

Rounding off the story and returning to the stage set in the introduction. Actively conclude a report effectively and provide a comprehensive and well-thought-out evaluation of the subject matter. This evaluation should be concise and clear while addressing any problems and the research questions. In essence, the conclusion should provide a summary of the main findings of the report, along with the implications and potential applications of those findings. By doing so, it will allow the reader to better understand the potential impact on the field of study.

9. Perspectives

The last chapter of a book or movie with an open ending is what you need to think about regarding the perspective. It invites readers to continue the story by exploring the unfinished experiments and suggested clarifications. Additionally, the expectations for the contribution of the continued work are described. The statement may also suggest avenues for future research or highlight how the findings contribute to existing knowledge in the field. By including such a statement, readers will have a better understanding of the significance of the research and its potential implications for further new stories.

10. References

A list of literature where all the authors cited in the report can be found. Writing reference lists and keeping track of the references has been made much easier with reference management tools like Endnote, Mendeley, and others (Singh & Mayer, 2014). University of Copenhagen has a license to Endnote, which is a reliable and professional referencing software. Mendeley is free, but may have a tendency of making mistakes in the referencing, so please check your reference list. These can help track all your references and format them correctly. It is also possible to share references if you are writing together as a group. These tools all have word plugins allowing you to select the right citation style and help format your references automatically to ensure the same consistent style. Here, we recommend choosing the Harvard style. However, as with everything, it is important to make sure your reference list has been checked and edited manually as mistakes can still happen. For instructions on how to use citations, citation examples, and compiling a reference list can be found through various resources. Also, investigate scientific papers to learn about the style and examples. The reference list and type will be evaluated and form part of the grade as well as everything else, so do not skip over this lightly. If you are in doubt about the appropriate use of references, more information can be found in Taylor (2002).

11. Appendix or Supplementary

It is important to avoid including information in appendices or supplementary sections that are not directly relevant to the report's content. Keep in mind that appendices also require explanations to be adequately understood. Also, be cautious about adding unnecessary appendices or misplace key results that should have been included in the report.

Conclusion

Finalizing a thesis can be a daunting task, particularly when adapting to the academic writing process. Even if the research is well-conducted and

interesting, unclear writing can make it difficult for readers to appreciate the work. Therefore, it is crucial to have a clear storyline that conveys the importance of the work to the reader. Guiding the reader through the text and engaging them is essential. Although academic writing can be challenging, it is also an insightful experience that can teach how to crystallize problems for future situations. We hope this guideline can help you achieve the thesis you have been dreaming about that showcases all the hard work you have put into your project.

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