

Chapter 2

Thesis Structure

Karen was undertaking a PhD in engineering to investigate whether a new type of plastic was safe to use as cookware. When she started her lab work, she decided to begin writing her thesis, but despite her determination she was having trouble. I knew Karen well, and she was a very good student who had been interested in new plastics ever since her undergraduate studies several years ago.

Karen decided that the first thing to do was to write a review of the literature. I told her to send me an outline of how she expected to tackle it soon—but after two weeks nothing had yet appeared. I asked her what the problem was. ‘No problem’, she replied, ‘I just have a lot more papers to read. When I’ve read and summarized them, then I can start writing’. I reminded her that she’d told me a similar story a few weeks earlier: after reading a few more articles, she would indeed start writing. While reading those, however, she’d turned up several more. And then there was the material that she had listed to read in the future. Karen then showed me several summaries, and each was separate. At that point, I concluded that she was never going to start. Seemingly, Karen had told herself that finding ‘a few more papers’ was the reason for her continued delay, but from experience, I realized that her problem lay deeper.

Why We Have Trouble with New Tasks

When we start a new project, figuring out how to proceed is easy if the project is similar to things we’ve done in the past. Building a bookcase, say, is not a big challenge for someone who has already made a kitchen cupboard. But an entirely new task is another matter: every aspect is unfamiliar, and it is not obvious how to begin or what the obstacles will be. We may not even know how to think about the problem. Imagine the state of mind of someone whose practical experience is limited to building kitchen cupboards, but who is asked to build a three-bedroom house. There will be many questions: Where to buy the materials? What materials? What tools are needed? Will the walls be strong enough? How to arrange for plumbers and plasterers? What is the first step? The task of starting to write a thesis may be equally as challenging.

Research is unpredictable. In nearly every project I've been connected with, the conclusions contained some unexpected elements. In most projects the aim of the work changed as it progressed, sometimes several times. I've often—startlingly often!—had students say that their 'experiments had failed', but, when we had absorbed the implications of the supposed failure, new hypotheses emerged that resulted in breakthroughs in their research. On several occasions truly surprising conclusions were staring the student (and me) in the face, yet we failed to see them for weeks, or longer, because we were so hooked on what we *expected* to find. That is, continuing the analogy above, we may not even be sure of what kind of building we are trying to construct.

Moreover, the process of research is often not entirely rational. In the classical application of the 'scientific method', the researcher is supposed to develop a hypothesis, then design a crucial experiment to test it. If the hypothesis withstands this test a generalization is then argued for, and an advance in understanding has been made. But where did the hypothesis come from in the first place? I have a colleague whose favourite question is 'Why is this so?', and I've seen this innocent question spawn brilliant research projects on quite a few occasions. Research is a mixture of inspiration (hypothesis generation, musing over the odd and surprising, finding lines of attack on difficult problems) and rational thinking (design and execution of crucial experiments, analysis of results in terms of existing theory). Most of the books on research methods and design of experiments—there are hundreds of them—are concerned with the rational part, and fail to deal with the creative part, yet without the creative part no real research would be done, no new insights would be gained, and no new theories would be formulated.

A major part of producing a thesis is, of course, creating an account of the outcome of this rational-creative research process, and writing it is also a rational-creative process. However, the emphasis in the final product is far more on the rational side than the creative side—we have to convince the examiners with our arguments. Yet all of us know that we do write creatively, at least in the fine detail of it. We talk of our pens (or fingers on the keyboard) running ahead of our brains, as if our brains were the rational part of us and our fingers were the creative part. We tend to separate one from the other. Of course this is nonsense, and we know it, yet the experience is there.

Wrestling with this problem has led me to the view that all writing, like all research, involves the tension between the creative and the rational parts of our brains. It is this tension—as well as our lack of experience in the specific task of writing theses—that makes it so hard for us to start writing, and sometimes gives us 'writer's block'. To get started, we must resolve the tension.

Structuring Your Thesis

A colleague was concerned about the draft thesis that had been submitted to him by Henry, one of his students, and asked me to look at it. It was certainly difficult to know what was going on. Henry had written the draft straight from a logbook, experiment after experiment, in chronological order:

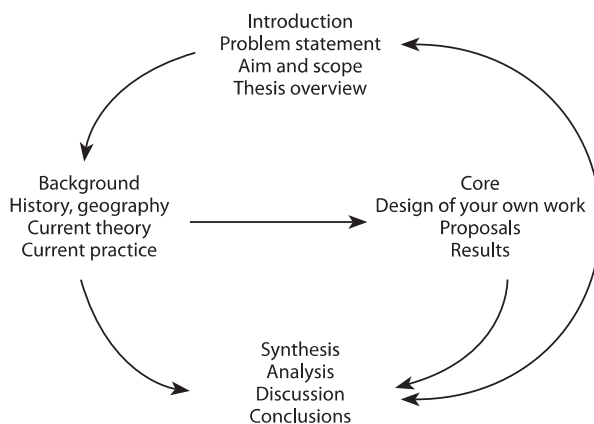
Experiment No. 37: as Experiment 36 failed to show the chemical reaction I expected, I next tried the effect of doubling the concentration of the active reagent ...

... and so on. In other words, Henry had presented a condensed diary, which certainly detailed the work he had undertaken but lacked the essential elements of a thesis: motivations for decisions made, interpretation and explanation, linking of data to conclusions, and argument supporting propositions and hypotheses. Your task as a writer is to document your processes, but equally to make these processes and the outcome of your work comprehensible to readers—not to explain how you spent your time, or to describe the hypotheses that ultimately didn’t make sense. You need to structure your thesis in such a way that you take the reader from the aim to the conclusions, via the evidence and arguments, in the clearest possible way.

As noted, there is no such thing as a standard thesis, but a careful reading of the guidelines for examination does suggest that there is a standard thesis *structure*. In essence, a thesis must first motivate the study, present background material and conduct a study. Results must be well argued and displayed, and the thesis has to end with a sound conclusion. My experience is that this standard structure works well for theses in the physical, biomedical, mathematical, and social sciences. The nature of research in the humanities is different from that in the sciences, and different forms of reportage may be appropriate for theses in different areas.

The ‘Standard’ Thesis Structure

The standard thesis structure has four parts: an *introduction*, the *background*, the *core* (for want of a better word), and a *synthesis*. Note how, as illustrated in the following figure, the sections are connected to each other. A conclusion responds directly to an aim, for example, and the background must directly foreshadow the core.



Some of these parts might contain more than one chapter, and the core might be more than half the thesis. Each of these parts has a distinct role.

The *introduction* explains what the thesis is about: the problem that the thesis is concerned with, the aims and scope, and the thesis structure. In some disciplines it includes an overview of the findings. An introduction is typically written for a wider readership than the bulk of the thesis, and may use illustrative examples to help underpin the reader's understanding of what you are trying to achieve. Such examples help to create a narrative that a reader can use as context for your work. However, an introduction isn't an essay—the only purpose it has is to introduce the research. You should outline the problem you have investigated, explain the aim of the research and any limits on the scope of the work, and then provide an overview of what lies ahead. Five to ten pages is ample.

The *background* is the knowledge required before a reader can understand your research: relevant history, context, current knowledge, theory and practice, and other researchers' views. In the background, your purpose is to position your study in the context of what has gone before, what is currently taking place, and how research in the area is conducted. It might contain a historical review. If the research is location-specific (an investigation of diet in low-income suburbs, for example, or an examination of how a dialect is changing) you will need to describe the study area and its characteristics; if the research is technology-specific (such as a study of food packaging or the yield of a harvesting machine) you will need to describe the specifics of this technology and how it affects the questions you can ask. The background usually contains a chapter reviewing current theory or practice, and may include the results of preliminary experiments or surveys carried out to help you feel your way into the problem. Experiments may also be used to establish benchmarks based on other work against which your work is to be measured, and these too form part of the background.

The *core* concerns your own work: your propositions or hypotheses, innovations, experimental designs, surveys and reviews, results, analysis, and so on. (This is sometimes called the contribution, though in a strong thesis the background too forms part of the contribution, as other researchers may value your interpretation and analysis of past work as much as they value the 'new' work presented in the core.) The core can easily form the bulk of the thesis and consist of several chapters.

The *synthesis* draws together your contribution to the topic. It will usually contain a discussion in which you critically examine your own results in the light of the previous state of the subject as outlined in the background, and make judgments as to what has been learnt in your work; the discussion may be a separate chapter, or may be integrated with the detailed work in the core. Finally, it is where you summarise the discussion and evaluation to produce conclusions. These should respond directly to the aim of the work as stated in the introduction.

The structure of the core varies greatly from discipline. In one thesis, the first of the chapters in the core might be a description of a survey tool and an explanation of how it is linked to an investigation of why obese people make poor dietary choices; the next might be a presentation and statistical analysis of the results; and the next

two chapters a presentation of a detailed study of a small number of individuals, looking at the impact of methods of changing their behaviour. In another thesis, the first core chapter might sketch why it is plausible that a particular food has an effect on the immune system; the next might propose specific chemistry that would cause this effect; the next might describe an experimental design to test for this chemistry; and so on.

A common factor is that the core is a narrative leading from a proposition to an outcome, linked by evidence and argument. In a more complex thesis, there may be a series of linked propositions, each independently supported by evidence and argument. I return to this issue in Chap. 7.

Below is a typical application of this structure, for a thesis examining the role of labels in diet choices. The thesis has three background chapters, which examine two aspects of labelling—legislative requirements and marketing—and social issues around food choices. These insights are used to develop a research survey for identifying the level of understanding of and belief in labels, which in turn is used to propose and test the impact of alternative labelling mechanisms.

The Influence of Food Labelling on Young Adult Diet
Chapter 1 Introduction
Chapter 2 Food Labelling Legislation
Chapter 3 Food Marketing Strategies
Chapter 4 Factors in Young Adult Choices
Chapter 5 Research Method
Chapter 6 Comprehensibility of Food Labels
Chapter 7 Alternative Label Designs
Chapter 8 Identification of Effective Labelling Factors
Chapter 9 Discussion
Chapter 10 Conclusions

These four parts (introduction, background, core, and synthesis) are examined in detail in Chaps. 5–10. My aim in this chapter is to convince you that you should ensure that each of them is progressively developed as your writing proceeds. A strong thesis is the product of considered work, where there has been opportunity to debate, revise, and evaluate each chapter at leisure; and is particularly strong if the components are tightly integrated. This integration is most easily achieved if they are written concurrently.

How many chapters should a PhD thesis have? If there are four main parts, each containing one to three chapters, we should not expect more than eight or ten chapters altogether. Many theses are accomplished in five to seven chapters. If you have more, you should suspect that some are really only sections, and need to be consolidated. In some disciplines, theses are assembled by editing papers that the student has published during the candidature to produce a coherent whole. With careless editing, such an approach can easily lead to a series of brief or fragmentary chapters that don’t form a consistent and sustained argument; that is, the collection cannot in itself be considered a thesis. In far too many cases some of these chapters are preliminary work, or work that it is off-topic, that shouldn’t be included at all. My experience is that producing a thesis in this way is usually much harder than the student expects—often the student feels that, since the papers were published, they

are ‘finished’ and all that is required is to gather them together—whereas even an experienced writer needs at least 5 or 6 months to turn a set of papers into an acceptable thesis.

My university once asked me to report on a request for financial assistance to publish a thesis as a book. It had around thirty chapters! The simple and coherent structure discussed above was totally obscured by the proliferation of chapters with seemingly arbitrary titles. The effect was total fragmentation of the reasoning and impact, and I was surprised that the examiners had passed it.

Narrative

One way to think of the role of structure, and signposting, is as a kind of guide that walks readers along a road from what they did know (past knowledge) to what they should know (a knowledge frontier). When you write a thesis, it can be helpful to reflect on what you knew—and how you thought—when you began your work. This earlier ‘you’ is the person you are writing for. The story, or narrative, that takes the reader along the road should be as straightforward as you can make it. That is, you may think to yourself: I have had to fumble, and explore, and make mistakes to get here, but I am now writing the guidebook that helps the next person to painlessly come to the same point of view and the same knowledge.

A key element to good writing is to clearly understand what the writing is meant to achieve. In my view, the twin concepts of narrative and audience—what you are trying to say, and who you are saying it to—are the most important lessons a writer can learn.

Look for the structure behind the material you are describing, and don’t confuse narrative with structure. The narrative concerns how you want the reader’s thoughts to develop as they read the thesis. The structure is how the material is organized to create a narrative. Different structures may be appropriate in different areas, particularly between the humanities and (in the broadest sense) sciences. In an empirical study, the structure might be: the problem and its significance; relationship to previous work; derivation of hypotheses; design of experiments; results; analysis and interpretations; conclusions (with, perhaps, two series of experiments, the second resting on the outcomes of the first). In contrast, in a literary study the structure might be: the purpose of the study and its contribution to knowledge; evaluation of previous studies; procedures, limitations, and assumptions; sources and documentation; analysis of facts and evaluation of evidence; conclusions. These structures are not identical, but there are strong similarities.

There are other differences between theses. In some disciplines, it is the norm for a thesis to be a consolidation of several papers; in others, the thesis is usually a single large piece of work. Some emphasize quantitative work, with, in the extreme, a thesis where the contribution is mathematical theories or lab experiments that lead to precisely quantifiable outcomes; others emphasize qualitative work, with, for example, discussion and argument based on documentary sources and other researchers’ interpretations of records of events.

Something that all theses have in common is the need for analysis and reflective consideration of the issues. Too often, researchers run the risk of merely describing their complex settings and ignore the need to demonstrate critical thinking.

Non-standard Thesis Structures

Some theses do not fit into a standard structure. Across a wide range of disciplines there is a trend towards a blending, for example, of quantitative and qualitative approaches. Such work might include, for example, an in-depth examination of the context and history of a situation before arriving at a ‘statement of the problem’. A quantitative survey might inform the development of interview questions, and these in turn might lead to analyses of the results that may suggest yet another series of questions. A series of chemical experiments may be inspired by a revisiting of a historical dispute, and be built on an analysis of arguments for competing methodologies. A conceptual framework may be an outcome and not a starting point.

If you are writing a thesis that relies on a non-standard structure—or are writing a thesis where the approach and problem might, in traditional terms, be ‘interdisciplinary’—don’t make the mistake of trying to reinvent the form of the thesis from scratch. Take the time to find other theses that have pursued similar problems in a similar way; read these theses, and others, to help yourself decide how your work should be organized and presented. Make sure you are familiar with the methods of both qualitative and quantitative research; there are many excellent books on these topics, some written for specific disciplines but readable by a broad audience, such as the books on statistical research methods for psychology. And it is essential that you establish a clear line of argument throughout your work.

As discussed in Chap. 1, be sure that you know the criteria for examination. Just because you are doing something ‘different’, you are not excused from creating a strong academic argument that is underpinned by sound evidence, credible analysis, and clear writing. How to use these elements in creation of a strong thesis is the subject of the next few chapters.

Summary of Chapter 2: Thesis Structure

Your thesis should be organized as follows.

1. An Introductory Chapter

- Tell the reader the problem you are tackling in this project.
- State clearly how you aim to deal with this problem.
- Limit the scope of your study.
- Sketch out how the thesis is structured to achieve your aim.

2. Background Chapters

- Include in these chapters all the material required to lead up to your own work.
- Ensure that there is a flow of narrative that explains why each topic is being discussed.

3. A ‘Core’ Account of Your Own Work

- Begin with a formal statement of your hypotheses or research questions.
- Follow this with an account of the methods you chose to test your hypotheses or answer your questions, and why you chose them.
- Report the results of applying these methods.

4. Synthesis

- You are now ready to pull the whole thesis together.
- Discuss the implications of your results.
- Draw strong conclusions backed up by your discussion.
- Check that they respond to the aim stated in your introduction.

Things to consider:

- Are you are blocked in your writing, or procrastinating? Do you understand why? If not, discuss it with someone.
- Think about how your thesis will work as a narrative.
- Decisions about organization should have a rational foundation. Satisfy yourself that you have good reasons for your chosen thesis structure.

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