

# Chapter 1

## **ENJOY WRITING YOUR SCIENCE THESIS OR DISSERTATION!**

We are assuming you have more than enough reading to do and possibly very little time. This chapter is a short overall guide with information summarised under useful headings. It is meant to be read as a whole and will give you a basic understanding of the standard conventions of dissertation and thesis writing, along with suggestions as to the best way of approaching the task. It will help you streamline the process of producing a rational and readable dissertation, thesis, or yearly report for a BSc, BA, BEng, MSc, MPhil, MEng, PhD, DPhil—or any other degree.

The rest of the book provides more detailed advice about the different aspects of thesis and dissertation writing. Read the parts that are useful to you, take what is helpful and leave what is not.

We are also assuming that you will type your thesis on a computer, that you have some basic word processing skills, and that you have access to a library in which you can carry out literature searches (see *Chapter 12: Resources*).

### **What are the Rules?**

There are very few rules for writing a dissertation or thesis. The rules that do exist mainly concern the formatting of your work (number of copies, layout, Title Page, Abstract or Summary, binding and so on) and these differ between departments and universities. Find out your local rules as soon as possible.

While there are few rules, there are many conventions—modes of writing that we all conform to, usually because they are efficient ways of conveying information. Each discipline has its own conventions for the structure of theses and dissertations. The best way of finding out about the conventions in your area of research, and your department is to ask your supervisor to recommend a good recent dissertation or thesis in your own field as a guide to form, content and style.

## **Structure**

As with any other story, the structure of a scientific thesis or dissertation has three parts: the beginning, the middle, and the end. In its final form your dissertation or thesis will probably be laid out something like this:

### **The Beginning:**

Title Page

Abstract

Dedication

Acknowledgements

Table of Contents

List of Figures

List of Tables

List of Appendices

List of Abbreviations (also known as 'Nomenclature' in some disciplines)

Introduction (including a literature review)

### **The Middle:**

Materials and Methods/Experimental Techniques

Results

### **The End:**

Discussion

References (also known as 'Bibliography' in some disciplines)

Glossary

Appendices

Published Papers

You probably will not have all these sections in your thesis or dissertation, but this scheme provides a basic structure from which to plan your writing.

## **Thesis and Dissertation Templates**

Some departments have ‘thesis templates’ available over the World Wide Web or on floppy disk. These give you the basic structure of the thesis (Title Page, Abstract, Introduction, Results pages, etc.) all you have to do is to fill in the blanks with your own text. Before you start planning your thesis or dissertation, find out if there is a template that you should be using (see *Chapter 12: Resources*).

## **The Importance of Planning**

A dissertation or thesis is not simply a list of experiments with a vague outline of what they all mean. The text needs a clear structure that starts by introducing the reader to the topic, states the aim of the research, shows the results and then discusses their significance. You need a plan. Without one, it is easy to overlook important points or jump about randomly from idea to idea.

This guide is written on the assumption that you will first develop a complete plan of your thesis or dissertation. Only when this is in place and you can see the structure of your text and have defined your aim, should you start writing.

## **Familiarise Yourself With the Appropriate Format and Style**

A useful first exercise is to have a careful look through a few recent theses in your field. Browse through them to see how the work has been divided into sections. Look at the layout, formatting, and font. Decide what you like and what you do not like.

## **Get Your Information into a Workable Form**

To start making your plan, you need your information (ideas, calculations, data, etc.) in a form that is easy to arrange and rearrange. Decide on the

key points for each section of your thesis or dissertation. You could note the points on paper, on computer, or write them on index cards. Once you have your key points, shuffle them about until you are happy with the order.

## **Creating a Plan for Your Thesis or Dissertation**

One sensible approach is to make notes for your project in the following order:

**Materials and Methods**, also known as ‘Experimental’, ‘Experimental techniques’, ‘Sampling strategy and methodology’, ‘General procedures’, ‘Data acquisition and processing’, etc. This chapter of your thesis covers what you did and how you did it.

**References**. This chapter tells the reader where you got your ideas and information from.

**Results**. This states what you learnt from your experiments.

**Introduction**. This introduces the reader to your field of research, your aims, and the experimental system in which you have been working.

**Discussion**. This should relate the significance of your findings to your field of study, and give your conclusions and suggestions for future research.

**Abstract**. This is a condensed version of your whole dissertation or thesis.

Planning your project in this order helps you to see what you did (Materials and Methods) and what you have achieved (Results); which is often different from what you set out to do and achieve. It then helps you to re-evaluate your original aim, and to alter that aim if you have not achieved it, so you can place your results and conclusions in the best context.

## **Planning Materials and Methods**

This chapter of your dissertation or thesis tells the reader what you did and how you did it; it is really just a recipe section. The Materials and Methods that you present must be absolutely accurate because someone

reading your thesis or dissertation should be able to repeat your work exactly. Include all the details they might need, such as the pH of solutions, the names of manufacturers of chemicals and apparatus, etc.

Do not simply set out your materials and methods in the order in which you did the experiments. Look through your materials and methods, give each a heading and then group them according to type. Within each group of materials and methods put the generally used materials and methods first, followed by the more specialised ones. If necessary include your methodology for statistical analyses, approximation methods and estimates of error, etc. Do not include all the materials and methods you used—just the ones that are relevant to your final project.

If you have written computer programs that could come under materials or methods it may be easier to put them in an appendix. If you have used available computer programs and databases or Web sites in your research, reference them fully.

For some subjects, particularly theoretical disciplines, it will be necessary to carry out a literature survey before planning this section of your thesis or dissertation (see *Chapter 12: Resources*).



**Fig. 1.1** Describe any unusual or specialist materials or method.

## **Do not confuse materials and methods with results**

Your Materials and Methods chapter is simply a set of instructions for the reader—like giving the recipe for making a cake. Results are what you found out from your experiments, the data you have generated. *Chapter 3: Planning and Writing the Materials and Methods / Experimental Techniques* will give you further information on the exact contents and how best to arrange and lay out your work, including the use of appendices and tables.

## **Planning Results Sections**

The results are the core of your thesis. You need to present them well so your examiners can see what you have achieved. In your Results chapter(s) you have to explain why you did your experiments and what you learnt from them. Remember, you are not giving detailed protocols, which are in Materials and Methods (see *Chapter 4: Planning and Writing the Results*).

The first thing you need to do is get your aims clear. Why have you been doing your research? What have you been trying to show in your experiments? Try and pose your aim as a single question or statement. You can then arrange your results to best address this aim. Spend time looking through your notebooks and noting all your results, even for those experiments which went wrong. Keep these notes simple, just one sentence for each main result. Then, before planning your Results chapter in full, do a literature survey—a review of all the literature (books journal articles, Web sites, etc.) that might be relevant to your project. You could leave the literature survey until you write the Introduction, but doing it at this point will help remind you of the significance of your results (see *Chapter 12: Resources*).

Decide on your most important results and the order in which to present them. Start with the results that are the simplest and underpin your other work. Once you have set these down and are on solid ground, move to the next result, building to support your aims. Present your results in the most logical and persuasive order; this might not be the order in which they were produced. Do not present irrelevant experiments and results simply because you have them; they may confuse your examiners and are unnecessary.

Once you have ordered your results into coherent groupings it is worth considering how many Results chapters to have. If you have a number of

markedly different key results, form a separate chapter around each of them. Generally there are no rules as to how many Results chapters your thesis should have; divide the Results into as many chapters as are necessary to group your work into logical and easily understood sections.

If you have a number of Results chapters it often makes sense to provide a brief introduction to each one, describing your strategy and specific points relevant to that section, followed by the results themselves and then a short discussion. This will give the reader a detailed critique and an immediate understanding of each result. The wider implications of your findings can be covered in the Discussion chapter.

Figures, tables and appendices are often extremely helpful for summarising a large amount of experimental data. Draft these before creating them and discuss the main points of each one in your text (see *Chapter 7: Figures and Tables* and *Chapter 8: Deciding on a Title, and Planning and Writing the Other Bits*).

You will probably find that as you write your Results chapter you think of points that should go into your Introduction and Discussion chapters. Keep a note of these as you go along, either on a computer file or in a notebook.

## **Planning Your Introduction**

In your Introduction, start broadly laying out the background of your research. Then narrow down to your project and the specific question you are trying to address—your aim. Finish the Introduction with a few points about how you have tackled the question experimentally, to lead the reader into your Results chapter (see *Chapter 5: Planning and Writing the Introduction*).

If you did not carry out a literature survey when planning your Results you must do one now, so that you fully understand the background to your research. Cite your references as you write, so you know each of your statements can be supported by publications.

## **The beginning**

Begin by giving the reader the background to your project. Note down all the points you want to make—just key words and simple sentences. Arrange

these points so you start by describing the field in which you are working. Either give a short history of your field of study, including the main theories and findings, or simply review the current situation (which is probably easier). Remember that the reader cannot ask you questions while they read, so you have to provide them with all the information they need to understand your project.

### **The middle**

Next, narrow down to your particular area of interest: tell the reader why it is interesting and why you chose to study it. Cover any important findings or theories which led to your project or which affected your work, referencing wherever necessary.

### **The end**

State your aim and then give a brief introduction to your experimental approach to prepare the reader for your Results chapters.

### **Introduction and literature survey sections**

In some disciplines it is appropriate to divide the Introduction into two chapters, the first describing your project and its significance, the second providing a review of the literature and/or the theoretical background to the project, including mathematical concepts or underlying theories and experimental approaches. Organise your Introduction or introductory chapters into logical and easily understood sections.

### **Planning Your Discussion**

Your approach when planning the points for your Discussion should be the opposite to that when planning the Introduction. Start with the experimental aspects of your findings and consider how your results have addressed your aim. Then broaden out to show their relevance to the general

field of your research and state the conclusions that can be derived from your work (see *Chapter 6: Planning and Writing the Discussion*).

## **The beginning**

Start by outlining the general thrust of your argument—restate your aims.

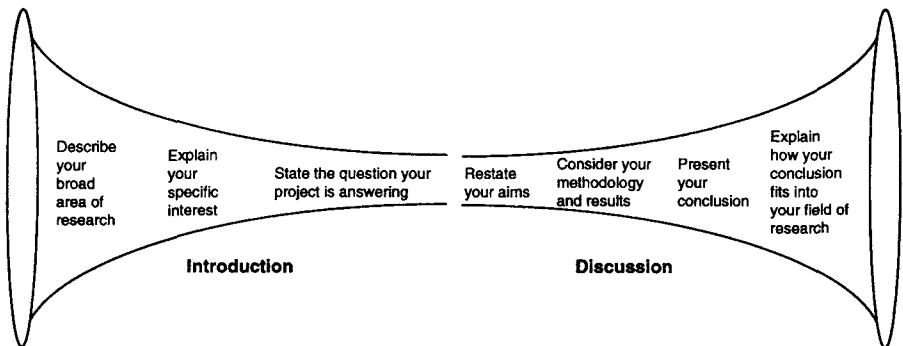
## **The middle**

Discuss your results individually, then relate them to your field of research. Be fully aware of the background to your project, the Introduction, because this may affect your conclusion.

## **The end**

Next you will give your conclusion. Make sure it is supported by your results and discussion. Some disciplines favour putting the conclusion in a separate section, so check to see what is conventional in your field.

At the very end, whatever your results and however successful you have been, finish on a positive note by pointing out interesting avenues for future work that arise from your project. If appropriate, ‘suggestions for future research’ may be placed in a separate section.



**Fig. 1.2** The structure of the Introduction and Discussion.

## **Planning and Writing Your Abstract**

An abstract is a condensed version of your whole dissertation or thesis. Your Abstract should be short, not more than one side of paper, and without headings. Make it a simple, positive and punchy account of your project that addresses the following:

- what question are you asking?
- within which experimental system are you working?
- what are your results?
- what is your answer to the question posed?

As with the main body of your thesis, while this reads logically and is the best order for presentation, it is not the most sensible order in which to write. Plan your Abstract by writing brief statements about your project in this order: (1) Materials and Methods/Experimental Techniques; (2) Results; (3) Introduction; (4) Discussion. Then rearrange these statements so that they answer the four questions in the order above.

For some degrees, such as some doctorates, you are required to submit an Abstract and Title to your university several months before submitting your thesis. Find out if this is the case for you. Writing an abstract is a good way to start you thinking about the contents of your thesis and give you a concise version of the final work, which will help you with later planning (see *Chapter 8: Deciding on a Title, and Planning and Writing the Other Bits*).

## **Composing Your Title**

Having planned your Abstract you should have a fairly good idea of what your thesis is about and should be ready to compose your title. If you are finding it difficult to think of a title, try re-stating your aim as a title. A short descriptive title is best, one which tells the reader about the contents of the thesis. We give you examples of suitable and unsuitable titles in *Chapter 8: Deciding on a Title, and Planning and Writing the Other Bits*.

## **Figures, Tables and Appendices**

Figures, Tables and Appendices are used for presenting your data to the examiners and for explanatory diagrams of something you are discussing in the text. Plan their contents carefully. Discuss only their most important points in your text, you do not need to discuss every detail. Each figure (including graphs), table and appendix needs a title, and figures and tables also need annotation and legends. Each one must also be referred to in the text. Put figures and tables as close as possible to where you discuss them; appendices usually go at the back of the thesis.

Prepare your figures before you print the final version of your thesis or dissertation. If you number each figure in advance it will help you spot any errors, such as having two figures with the same number (see *Chapter 7: Figures and Tables*, *Chapter 8: Deciding on a Title*, and *Planning and Writing the Other Bits*, and *Chapter 9: Proofreading, Printing, Binding and Submission*).

## **Writing Throughout the Course of Your Project**

If you begin writing your thesis on computer as soon as you start your project, you will have less work to do at the end. Begin with your Materials and Methods/Experimental Techniques and References.

### **Materials and methods/experimental techniques**

Write your Materials and Methods into a word processing file as you go along. Do not worry about organisation of this information at this point. Writing your materials and methods now will help ensure they are accurate and that you have included all of them. This is a tedious section to write if you leave it all until the end, when you could well be panicking or bored of the whole thing, you could easily make mistakes and omissions (see *Chapter 3: Planning and Writing Materials and Methods/Experimental Techniques*).

## **References/bibliography**

When you come across useful references, enter the full reference description into a reference database program or word processing file. This description generally includes: a list of the authors, year of publication, title, correct journal abbreviation, volume number and page numbers. There may be regulations as to what reference details your department or university requires in your thesis, so make sure you know these before you start adding your references (see *Chapter 2: Planning and Writing the References (Bibliography)*).

Start to collect a library of photocopies of important references, so that you have these to hand when you need them.

## **Overall Content**

Very roughly, your Introduction will be 20–30% of the whole, your Materials and Methods/Experimental Techniques 10–20%, your Results 35–45%, and your Discussion 20–25% (not counting your Title Page, Abstract, Table of Contents and other appendices).

## **Writing**

When you have your detailed plan, put all your notes together in the correct order and check that they make sense. Show the complete thesis plan to your supervisor and make whatever changes they suggest. You can then begin writing.

When you open your first word processing file, make sure you have the correct margins and (as far as possible) the correct page layout, so you do not have to make time-consuming changes to layout or the figures when you come to print the final draft. Usually you should use double or one and half line spacing, make sure you have sufficient margins around the text; leave at least 4 cm in the left margin for binding the pages together. Find out if your department or university has any rules about the format and layout of the thesis or dissertation. If there is a word limit for your thesis, remember to use your word processing program to carry out a word count

regularly so that you can keep track of the size of the thesis (see *Chapter 13: Layout*).

Make the figures and figure legends for each chapter as you go along; making them can be a welcome relief from typing, and you do not want to have to do them all at the end when you will be running short of time (see *Chapter 7: Figures and Tables*).

## **Putting Down the First Words**

Before you start writing have your plan in front of you. Use it when you write—that is what it is there for. Some people like to start by getting something down on paper, whatever it is. They then use these rough jottings as a basis from which to write their text. Others prefer to spend much longer on the initial writing, getting it as near perfect as they can. Choose whichever approach suits you best. If you are using the ‘put anything down and change later’ method, do not be too free in your approach to the first draft: do not go for stream of consciousness writing—it can be a nightmare trying to sort out your ideas later.

## **Drafts**

Your text will inevitably go through a number of drafts, pruning and clarifying the language each time, before it is ready for submission. With a large text such as a thesis or a dissertation you will probably go through this drafting process for each of your chapters or sections individually—some will need more re-drafting than others. When you complete a draft print it out on paper—you will get a better idea of how it looks, and it is easier to spot mistakes on paper than on screen.

It is best to give yourself a break between writing and checking your drafts. It is a lot easier to spot mistakes when you have put a bit of distance between you and the draft. Try and imagine yourself as another scientist to see if your text makes sense. If you can persuade a friend or colleague to check it for you this will help, as they will spot mistakes that you have missed. Make sure they know at least a bit about your subject and have a good command of English.

Give a copy of each draft chapter to your supervisor to read and correct. Make the draft as good as you can so your supervisor will not waste their time correcting small mistakes such as spelling errors. Take note of your supervisor's comments and corrections (see *Chapter 11: Supervision*). Go through the draft adding information you have missed, correcting mistakes and awkward constructions.

When your thesis or dissertation is in its final stages, add the following sections (not all of which are necessary for every dissertation or thesis, see *Chapter 8: Deciding on a Title, and Planning and Writing the Other Bits*):

- Title Page
- Abstract
- Dedication
- Acknowledgements
- Table of Contents
- List of Figures
- List of Tables
- List of Appendices
- List of Abbreviations (also known as 'Nomenclature' in some disciplines)
- References (also known as 'Bibliography' in some disciplines)
- Glossary
- Appendices
- Published Papers

Before you finally submit your thesis make sure it is thoroughly and accurately proofread.

## **Use of English**

Your text is a serious scientific document and it should be prepared with the same attention to detail as would be expected of a paper submitted to 'Nature' or 'Science'. Reading a dissertation or thesis can be as hard work for an examiner as writing one is for you, so your text has to be presented as clearly as possible, without ambiguity, and with sufficient introduction to be understandable. Examiners have very little time between teaching, grant writing, administrative duties, etc. and they may well have to read

your text on the train, or in between taking the kids to ballet practise and trying to get the exhaust fixed on their car. Make the job of reading your dissertation or thesis as easy as possible: the harder an examiner finds your text to read, the less well inclined they will be towards you and your project—which is not a good thing. The harder you work on making your text clear and easily understandable, the less work the examiner will have to do deciphering your text and the better disposed they will be towards you and your project—which is a good thing. Keep your style crisp and to the point, be concise, and use plain English. Use accepted scientific terms wherever they are appropriate. Use the correct units and their abbreviations. Use headings, figures and tables to break up your text into easily readable sections so that both you and the reader can keep track of it. In your Introduction and Discussion you can be more discursive than in your Materials and Methods, and Results, but keep your writing concise and focused all the same. Use appendices for information that is a necessary part of your project but would clutter your text if put in with it.

Avoid wordiness, vagueness, colloquialisms and contractions (*it's, lab,* etc.) and understand specialist terminology if you use it. Use the spell-checker on your word processing program; there is no excuse for spelling mistakes. Check your grammar is correct and appropriate. It is best to avoid the passive, 'the digests were continued', it can give you the right tone of detachment, but can also be very wordy; try and use active constructions wherever possible, for example, 'digestion continued' (see *Chapter 14: Use of English* and *Appendices: 1, 2, 3, and 4*).

## **The Importance of Good Presentation**

When people go for job interviews they make an effort to look smart—which shows that they are taking the interview seriously. If your manuscript looks good the examiners are more likely to take you and the project seriously. Take into account any conventions of your discipline or department and stick to the same format and layout consistently throughout your thesis or dissertation. Before you submit your thesis print a complete copy, check and proofread it thoroughly one last time (see *Chapter 13: Layout* and *Chapter 9: Proofreading, Printing, Binding and Submission*).

## Plagiarism

Plagiarism is stealing other people's ideas, writings, or inventions and passing them off as one's own. When using other people's ideas or writings, make it clear that they are the 'property' of their author by showing that you are quoting and giving a precise reference. If a student plagiarises someone's work and the theft is discovered, which it almost certainly will be, they can be failed without further question.

## Binding

If you are binding your papers together yourself, organise what you need in advance, and ask your supervisor for advice on what your department prefers. Some theses and dissertations, such as doctoral theses, need to be professionally bound. Find out in advance where the binders are, what they charge and how long they take.

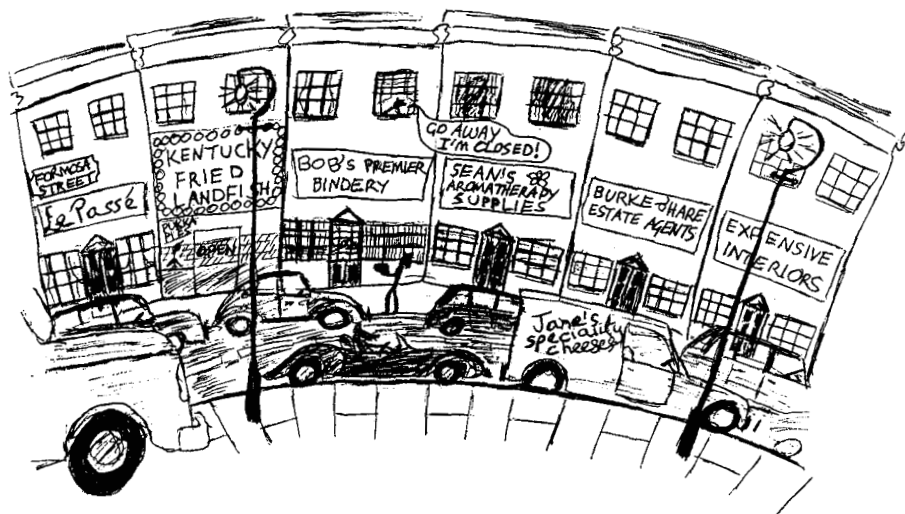


Fig. 1.3 Check when the binders are open.

## **Where to Write**

Writing your dissertation or thesis will be hard enough at the best of times. Find somewhere to write where you can concentrate on your work and will not be interrupted too often. You will be spending a lot of time in this place so make it comfortable. Your concentration will not be helped if you develop chronic backache, so check your chair is the right size and the table or desk the right height for you. Make sure you have easy access to cups of tea or coffee, biscuits, etc.

## **Resources**

### **Notebooks**

Organise your information well and keep it safe. Some of your information, such as notes from experiments, will be irreplaceable, some will take a lot of time to find again. Keep a small notebook or pad for jotting down ideas that could come to you at any time, in bed, on the bus or while eating breakfast.

### **Libraries**

All libraries offer the same basic services: providing books and journals, ordering articles for you, and allowing you to carry out reference database searches. They can also supply you with information such as lists of citation abbreviations and SI units. Get to know your librarian, who will be able to show you how the library and its facilities work and point you in the right direction when you are looking for information (see *Chapter 12: Resources*).

### **Your computer**

Learn to understand and love your computer, whether you have your own or are using one in your department. Your computer not only works as a magic typewriter that allows you to shift chunks of text around and correct

spelling mistakes at the click of a mouse; it also allows you to sort, store, and retrieve your information easily. Take time to learn how to work with the programs you are using (word processing, graphics, reference database programs, etc.) and peripheral devices such as scanners (see *Chapter 12: Resources*).

## **Using the Internet and World Wide Web**

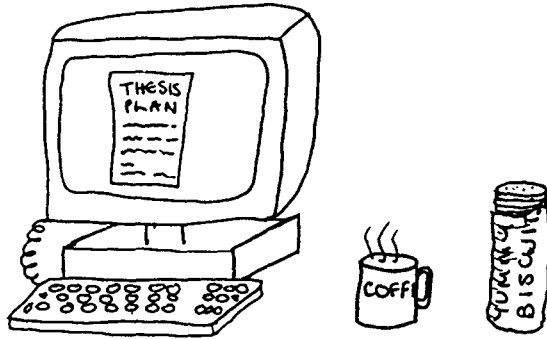
The Internet and World Wide Web can provide you with a lot of useful information, from important references to moral support from other people writing dissertations and theses. Learn how to use and enjoy them (see *Chapter 12: Resources*).

## **A reminder about good housekeeping**

Remember to keep copies of all your computer files on at least three floppy disks, and at least one on a hard disk. As disk to disk copying is where most problems occur, it is not enough to have a copy of your valuable thesis files on a disk with just one backup floppy disk. If you have not backed up your thesis and lose it, you will have no excuses. Also keep up-to-date dated printouts of all your documents just in case you lose everything you have on computer (see *Chapter 12: Resources*).

## **Your most important resource is yourself**

Remember, you are a human being and human beings do not operate like machines—although you might well feel like one at times. Obviously, you will have to work hard on your text but do not push yourself to the limit every day. Learn to manage your time and your tasks, alternating between boring repetitive jobs and more interesting ones. Set yourself achievable deadlines for each piece of work but do not get too upset if you run over your deadline, as inevitably you will from time to time.



**Fig. 1.4** The essentials of thesis writing.

## **Interim Reports**

You may well have to submit interim reports for your project, for example, quarterly or first year reports. Approach them in the same way as your dissertation or thesis, although they will mainly be concerned with materials and methods, and results. Try to produce as professional and well-written a document as possible. These reports might well be useable as parts of your final dissertation or thesis, which will save you a lot of work at the end of your project.

We will cover each chapter of your dissertation or thesis in detail in later chapters of this book and provide you with practical suggestions for presentation of data. We have also included a number of useful appendices.

Remember: start from a well thought-out detailed plan and you will succeed!

## **Key Points**

- Ask your supervisor to recommend a good recent dissertation or thesis in your own field as a guide to form, content and style
- Read your university or departmental rules on thesis submission, before you begin writing

- **Make a detailed plan of all your sections and chapters before you start writing; review your work in the order: Materials and Methods/ Experimental Techniques, Results, Introduction, Discussion**
- **Find out if there is a thesis or dissertation template for your department, and if so, use it**
- **Type Materials and Methods/Experimental Techniques, and References into appropriate computer files throughout the course of your project**