NUI Galway
OÉ Gaillimh

Writing a Scientific-Style Thesis

A Guide for Graduate Research Students

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Author's Preface

This guide aims to support graduate research students, and their supervisors, who are working in science subjects at NUI Galway. The motivation for developing such a resource comes from the recognition that students' knowledge and understanding of the thesis writing process may be uncertain. Moreover, students may experience some measure of anxiety and trepidation over the production of their theses. Naturally, graduate students in the sciences seek clarification and support before and during the thesis-writing process. Hence, this guide aims to provide clear, practical advice on aspects of thesis preparation, writing, and editing. I gratefully acknowledge the former and present Deans of Graduate Studies, Dr Pat Morgan and Prof Lucy Byrnes, for their support and guidance during the composition of this guide.

Dr Dermot Burns, Discipline of English, NUI Galway

Deans' Preface

We are delighted that this guide is available to graduate students to provide signposts to writing a scientific thesis.

We gratefully acknowledge our colleagues for reading drafts of this guide and providing constructive feedback. Thanks to Fawaz Aldabbagh, Michel Destrade, Maura Grealy, Conor Hayes, Mark Healy, Aisling McCluskey and Ger O'Connor.

The guide has an appropriate mix of general advice peppered with gems of wisdom. We encourage you to dip in as you prepare to write and consult the guide as you develop your thesis and in order to avoid many of the common mistakes. Writing well is a skill that is critical for your future careers. Our final piece of advice is to begin now: start to write today.

Dr Pat Morgan, Vice President for the Student Experience and previous Dean of Graduate Studies

Prof Lucy Byrnes, Dean of Graduate Studies

1 Purpose of Writing a Scientific-Style Thesis

The aim of this guide is to provide a systematic, valuable and inspiring resource which will be an accessible and stimulating reference point for postgraduate research students (and their supervisors) throughout the duration of their studies. Students should acquire and develop a core of generic writing skills that are relevant across the range of academic disciplines and topics, but which pertain specifically to the writing of a successful scientific-style postgraduate thesis.

It is hoped that this manual will assist students in learning how to:

- plan, write and revise a thesis to the standard required and in the correct format
- improve writing technique and accuracy (including matters of style, syntax, grammar, punctuation, spelling and paragraphing)
- become increasingly aware of, and sensitive to, important issues regarding academic honesty, plagiarism and correct citation practice.

The manual is written in a user-friendly style. It is addressed directly to students. Certain parts (specifically the sections about the mechanics of writing) will, necessarily, be overtly didactic; however, all efforts have been made to ensure that the wording, phrasing and general format of the manual are accessible, simple and direct, so that postgraduate students feel comfortable using the resource as a valuable text in its entirety, as well as a menu from which to choose, according to specific needs or interests.

2 Introduction

The purpose of writing a thesis is to demonstrate to an academic readership that you are competent in conducting and writing up a significant body of research. Therefore, you will need to develop the necessary writing skills to communicate your research at the appropriate level to experts in your chosen field of study.

2.1 Graduate research and academic writing

As a research student, you have a very important position within the university community. You will be making a significant contribution to knowledge and understanding in your chosen area by authoring a thesis that must be suitable for publication in whole or in part. If you are studying for a doctorate, your thesis is the key component of your PhD: in conjunction with your *viva*, it is the principal means by which your expertise will be assessed. The ability to compose a thorough, detailed and accurate thesis is a vital skill for doctoral students and those studying at research Master's level to acquire and refine. This manual aims to help you to develop the authoring skill and writing competency that will help you to achieve the award of Doctor or Master. It seeks to lay the foundations of your success as a writer in your career in academia, industry or public service. General guidance is offered in this manual. For more detailed and specific help with your discipline's requirements, you should ask your supervisor and check your School's website so that you are following the correct format and style for your particular circumstances.

2.2 Definition of a thesis

The word 'thesis' is derived from the Greek word for 'position', referring to an intellectual proposition. 'Dissertation' comes from the Latin *dissertātiō*, meaning 'discourse'. Although these terms can have different meanings in different contexts, in this guide they are used interchangeably to mean the same thing: the document that you will complete and submit as the main component of your postgraduate study. Your thesis, or dissertation, communicates the research questions, methodologies, findings and conclusions of your research. It is the written testament of your academic achievement.

Creating a thesis involves a number of important factors: seeing in your mind's eye what you want to write, planning it carefully, writing drafts, revising your ideas and producing a finished version for assessment (and perhaps publication). At each stage of the process, a number of issues may arise that need to be dealt with in order to ensure the success of your thesis. We can make effective and efficient progress by making some of these issues explicit. The two aims of this section are: to shed light on the common challenges associated with writing a postgraduate thesis and to identify some ways of managing them.

Your thesis is a key element in your postgraduate studies, whatever your discipline or topic. To write it effectively, you will need to acquire a set of academic writing skills which are fundamental to your success. Proficiency in academic writing will enable you to meet the required criteria for postgraduate study. Your thesis will probably be the longest piece of writing that you have attempted. Starting the journey to successful thesis completion requires you to think carefully about your academic writing skills, as well as your research methodology and data collection. By learning some useful techniques, you are making the first, important steps towards producing a coherent, well organized and accurately written thesis which is a true reflection of your efforts and expertise in your chosen area of research.

This manual provides technical guidance on writing a scientific-style thesis. Although there is no steadfast set of rules, these guidelines will hopefully be useful in helping you to get started.

Firstly, you will need to think about some important questions concerning your thesis.

- What is the purpose of the thesis?
- Does it provide evidence of original research? (Is this research significant?)
- Are you providing a thorough review of relevant literature?
- How is your work unique? How does it differ from other work on the subject?

Thinking about these key questions will help you to clarify your aims and help you to write the thesis with the appropriate amount of detail.

2.3 How your thesis is examined

An important perspective to consider is that of the examiners of your completed thesis. Gaining some understanding of some of the key features they are looking for in your written work should serve as useful when you plan, write and revise your dissertation. In *How to Examine a Thesis*, Lynne Price offers an informative insight into the way examiners approach and evaluate theses. Much of the following section is adapted from this useful and revealing text.

It should be remembered that examiners are not only subject specialists, but also established and successful academic writers: one of the key roles they play is to act as guardians for academic standards in higher degrees. These standards apply to writing skills as well as to the content of submitted theses. Comprehensive and detailed lists of amendments and errors in writing are commonly supplied by examiners. Therefore, it goes almost without saying that the more attention you pay to the accuracy of your writing, the more likely you are to create a favourable impression with your examiners. This section deals with some important points to bear in mind regarding the expectations of those who will assess your thesis.

2.3.1 Ways your thesis may be read by examiners

Some examiners will begin by checking the Bibliography of your thesis in order to ascertain whether you have sufficient knowledge of your chosen field of study. Others may read the Abstract, Table of Contents, Introduction and Discussion prior to reading the actual chapters themselves. Others still might read the thesis slowly and thoroughly from the first page to the final one. Whichever method your examiners choose to read your thesis, be assured that their reading will be scrupulous. Furthermore, they will be keeping a running list of typos and minor corrections as they go through your work. Thus, it is imperative that you create as favourable an impression as possible by writing as accurately as you can.

2.3.2 How examiners evaluate the central research question

In scientific theses, the key research question leading the thesis is normally defined before the postgraduate research starts. The student's original contribution to the field of study is made clear in terms of the experiments which will be performed to solve the central research question.

If you can state your central research question in a succinct, straightforward sentence, this should allow the examiners of your thesis to have a clear and precise notion of the core of your research. Make sure that you provide such a lucid, declarative statement in your abstract and also at the start of your actual thesis. Examiners will be investigating whether the thesis asks, and answers, a relevant central research question.

The Abstract you provide is a key page of your thesis – perhaps *the* most important of all. Firstly, it is the piece of writing that introduces your thesis to the world; secondly, it provides the set of vital points by which your thesis will be assessed. It is, therefore, crucial to explain the central hypothesis of your work as clearly as possible in your Abstract, as Pearce (2005, p. 52) affirms: 'It [the Abstract] remains the linchpin of its [the thesis'] claim to originality and the acid test of the author's grasp of his or her material'. For more detailed advice on how to write an Abstract, see section 6.4.4 of this guide.

2.3.3 How examiners evaluate whether objectives are achieved

In science subjects, the presentational format of a thesis should be adhered to, as explained in sections 6 and 8 of this guide. Thus, the connection between research questions, experiments, results and discussion is made clear. However, it is important to maintain correlation between the different sections of the thesis, so that your work looks like a coherent, cohesive entity and not a disjointed set of separate sections. A useful way to ensure that you achieve unity in your thesis is to make sure that the aims and objectives are described clearly in the Introduction, addressed explicitly in the Results chapters and discussed thoroughly in the Discussion. Overall, a clear line of thought should run through the thesis from beginning to end.

2.3.4 How examiners evaluate methodology

In a scientific-style thesis, the Materials and Methods section is of significant importance. The examiners will be asking themselves key questions with regard to your methodology, including:

- Why was this particular methodology chosen?
- How does this methodology provide new information on the subject?
- In what ways is the methodology original?
- Could the methodology be improved?
- Does the chosen methodology have any major, or minor, limitations?

(Adapted from Pearce, 2005, p.55.)

2.3.5 How examiners assess originality

One of the key criteria by which a PhD thesis is judged is that of its originality: how your research adds to the scholarly debate and/or field of knowledge of your chosen subject. The results in a scientific-style thesis must be new: they cannot have been present anywhere in the primary literature. As well as bearing this fundamental fact in mind, originality can also be construed in other, more subtle ways, as Gina Wisker (2008, pp. 355-6) points out below.

Originality is to be found in a thesis that:

- pushes the topic into new areas, beyond its obvious focus
- makes an original contribution to knowledge or understanding of the subject, in terms of topic area, method and experimental design, theoretical synthesis, or engagement with conceptual issues
- solves some significant problem or gathers original data
- reframes issues
- is imaginative in its approach to problems
- is creative yet rigorous
- goes beyond its sources to create a new position that critiques existing theoretical positions
- uses the empirical study to enlarge the theoretical understanding of the subject
- contains innovation, speculation, imaginative reconstruction and cognitive excitement – the author has clearly wrestled with the method and tried to shape it to gain new insights
- is comprehensive in its theoretical linkages or makes novel connections between areas of knowledge
- opens up neglected areas or takes a new viewpoint on an old problem
- shows something new has been learned and demonstrated, such that the reader is made to rethink a stance or opinion
- shows 'a spark of inspiration as well as perspiration'
- shows development towards independent research and innovation
- is innovative in content and adventurous in method – obviously at the leading edge in its particular field, with potential for yielding new knowledge
- makes a personal synthesis of an interpretative framework
- shows depth and breadth of scholarship – synthesising previous work and adding original insights/models/concepts
- argues against conventional views – presents new frameworks for interpreting the world
- applies established techniques to novel patterns, or devises new techniques that allow new questions to be addressed.

Thinking about how your writing may be judged against the above standards may help you to ensure that your postgraduate thesis is original.

2.3.6 How examiners assess knowledge of the field

You will be expected to demonstrate knowledge and appreciation of the important scholarly work which pertains to your research. Examiners will be checking to see whether your thesis displays a sound and thorough understanding of previous academic work on your topic. A well-written, comprehensive literature review should provide examiners with evidence that a research student has made the required effort to master his or her field of knowledge. A successful literature review should have two essential features: firstly, it should evaluate the relevant literature, rather than merely cite it; secondly, it should relate the material under review to the actual thesis itself.

2.4 Differences between Master's and PhD thesis

The models and standards required for the formatting of a research Master's and a PhD thesis vary. As a rule, your thesis format should adhere to format, structure and layout that are readable, compact and clear.

The Master's thesis should not exceed 45,000 words unless there are exceptional circumstances. This word limit is inclusive of Appendices, footnotes, tables and Bibliography.

The PhD thesis should not normally exceed 80,000 words, inclusive of Appendices, footnotes, figures, tables and Bibliography.

The University guidelines provide a set of criteria for both the research Master's and the PhD degree: http://www.nuigalway.ie/media/graduatestudies/files/university_guidelines_for_research_degree_programmes.pdf.

For a research Master's degree, a candidate must demonstrate that, in pursuance of an agreed project, s/he has met each of the following criteria:

- has made a contribution to understanding or knowledge
- can display an appropriate depth and breadth of understanding of the relevant field(s) of study
- has gained a corresponding level of expertise with respect to relevant methodologies and techniques.

Examiners will search for evidence of the above criteria in the thesis; an oral examination is not normally required.

For PhD theses, the following criteria are applied to examine whether the student has:

- made a significant contribution to understanding and knowledge
- completed work that is suitable for publication in whole or in part
- displayed an appropriate depth and breadth of knowledge and understanding of the relevant field(s) of study
- gained significant expertise with respect to basic and advanced methodologies and techniques.

Examiners will check the thesis for evidence of the above criteria; however, the oral examination, or *viva*, is critical in confirming that the candidate has met the required standard in respect of the assessment criteria.

2.5 Rules of Submission

A comprehensive version of the rules for submission of theses is available in the *University Guidelines for Research Degree Programmes:* http://www.nuigalway.ie/media/graduatestudies/files/university_guidelines_for_research_degree_programmes.pdf.

Some important points have been outlined in this section in order to highlight certain key thesis layout requirements.

It is very important for candidates to follow the directions on format, layout and presentation, as outlined below. You will need to check the complete rules and regulations in the *University Guidelines for Research Degree Programmes* before you submit your thesis for examination.

2.5.1 Research Master's thesis layout

- A thesis must be submitted in the registered name, i.e. the name on the student's ID card, which reflects the name on the student's birth certificate. The thesis will not be accepted by the Examinations Office unless the name on the thesis is exactly as registered.
- Two copies of the thesis must be lodged with the Examinations Office. Each copy must be accompanied by a completed form EOG 052 and a summary or abstract of no more than 300 words.
- There must be a title page which will have the following information:
  a. The full title of the thesis and the subtitle, if any.
  b. The total number of volumes if more than one and the number of the particular volume.
  c. The full name of the author, followed, if desired, by any qualifications.
  d. The qualification for which the thesis is submitted.
  e. the name(s) of the supervisor(s), school(s), component discipline(s) and institution
  f. The month of the year of submission.
- The title should describe the content of the thesis accurately and concisely.
- The Table of Contents shall immediately follow the title page.
- In terms of format and layout, the text must be printed on good quality (110 grams) A4 size paper with a left hand margin of 4 cm. A maximum of one-and-a-half line spacing, left justified only should be used. An easily readable layout and double-sided printing are recommended for the body of text. 12 point font size is recommended.
- Pages must be numbered consecutively, with page numbers located centrally at the bottom and chapter headers at the top of each page. Page numbers should start in Chapter 1 with Arabic numerals, with Roman numerals for earlier sections.
- Figures and tables should be located adjacent to the related text and numbered correctly. Each figure number should state the chapter number and a specific number for each figure and figures should be numbered in the order they appear in the chapter. For example, figure 4.3 is the third figure in chapter 4. A similar convention should be used in table numbering.
- The work shall be accompanied by a short summary (Abstract) of the contents and a Bibliography of the works consulted in its composition.

For research Master's Degrees (except for Medical Degrees), three copies of the thesis should be submitted to the Examinations Office by the dates stipulated in the *University Guidelines for Research Degree Programmes*. The three copies required include two gum bound copies and one hard bound copy which will be required for Library use. The binding shall be of a fixed kind in which leaves are permanently secured. A Summary or Abstract not exceeding 300 words is also required. In the case of Medical Degrees, four copies of the thesis should be submitted: two gum bound copies and two hardbound copies. A Summary or Abstract not exceeding 300 words is also required for Medical Degree theses.

Upon submission of your thesis to the Examinations Office, one copy is distributed to the External examiner, one copy is distributed to the Internal Examiner and one copy (the hard bound copy) is distributed to the Library after the graduation of the student.

2.5.2 PhD thesis layout

The candidate should refer to the *University Guidelines for Research Degree Programmes* for full details of required formatting and submission procedures (http://www.nuigalway.ie/media/graduatestudies/files/university_guidelines_for_research_degree_programmes.pdf). A list of some key points to bear in mind is provided below.

- Two copies of the thesis must be lodged with the Examinations Office. These should be spiral or gum bound. Each copy must be accompanied by a 'Summary of Contents', not exceeding 300 words in length and a completed copy of form EOG 020.
- There must be a title page which shall contain the following information:
- the full title (and sub-title, if any)
- the volume number and total number of volumes, if more than one
- the full name of the candidate, followed, if desired, by any degree and/or professional qualification(s)
- the name(s) of the supervisor(s), school(s), component discipline(s) and institution
- the month and year of submission.
- The title should describe the content of the thesis accurately and concisely.
- The Table of Contents should immediately follow the title page and not be overly-detailed.
- In terms of format and layout, the text must be printed on good quality (110 grams) A4 size paper with a left hand margin of 4 cm. A maximum of one-and-a-half line spacing, left justified only should be used. An easily readable layout and double-sided printing are recommended for the body of text. 12 point font size is recommended.
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- In terms of binding, the copies of the thesis presented initially for examination should be spiral or gum bound.
- The copy of the final bound thesis must be bound within boards with leaves permanently secured. The cover bears the title of the thesis, candidate's name, degree awarded and the date of submission. The spine bears the candidate's name, the degree awarded and the date of submission.
- An electronic copy of the final thesis must also be submitted, along with a completed copy of the Library Submission Form EOG 051.

3 Preparing to Write

Being well prepared is just as important for your writing as it is for your laboratory work. Adopt the same conscientious approach to both types of preparation during your postgraduate studies.

AN IMPORTANT NOTE OF CAUTION

Be attentive about backing up your files from the start of the writing process. Update your files regularly and save them in different ways, including email attachments, removable disks, external hard drives, etc. Technical advice on backing up can be found at http://www.nuigalway.ie/information-solutions-services/services-for-students/networkstorage/#tab4. Do not allow yourself to become another 'disaster story' about lost work.

Also, ensure the language is set to UK (not US) in the word processing software.

3.1 Before you begin

Remember that you are writing to communicate clearly, not to impress. Primarily, readers of scientific-style theses should notice the content, not the style, of writing. Adopt a careful approach to writing, much the same way as you would prepare carefully for an experiment. Consult peer reviewed research articles in journals for guidance on the style of presentation in your field. One of the best forms of preparation for writing your thesis is writing research papers. Such scientific writing experience and feedback from peer review is invaluable. In some cases, published papers may form the basis for thesis chapters. Gathering relevant resources and making useful plans and outlines are ways in which you can get ready for the act of writing. Make sure that when you sit down to write, you are in the right frame of mind to do so and have all of the necessary resources close at hand. Set yourself a target for that writing session and make sure that you achieve it.

3.2 Obtain copies of successful theses in your area of research

Find and study copies of successful theses in your area of research. Observe how they are structured. How long are the chapters? How long are the sections and sub-sections? What useful phrases are used? Use other theses as models for your own work. Effective academic writing can be achieved by imitating the good practice of other scholars who have already succeeded in producing postgraduate dissertations. Information on how to access theses at the University is available at: http://www.library.nuigalway.ie/collections/theses/. However, a note of caution: there is no perfect thesis and, whereas it is useful to review other theses in your field for general guidance, your thesis is unique and must be your own work.

3.3 Pre-writing activities

To help you to get started writing, do some prewriting activities such as organizing your references in the order in which you are going to use them in your work. It is highly advisable to create an outline of your thesis at the outset and to agree same with your supervisor. The outline should be supplemented with plans for each section. List the points you want to cover and arrange them until you are happy with the order.

3.4 Making time to write

Make time to write. Scientists are often busy doing laboratory work. Look at your weekly calendar and block out some time devoted solely to writing. If you are more alert early in the day, find times that suit you in the morning; if you are a 'night person', block out some writing sessions in the evenings.

3.5 Personal deadlines

Set yourself deadlines and stick to them. For example, tell yourself that the section you are writing must be completed by Saturday. Alternatively, you could not allow yourself to leave for holiday until you have submitted a specified chunk of text. You may find it useful to agree deadlines with your supervisor. Rewarding yourself for achieving these writing deadlines is a useful way to maintain motivation.

3.6 Writing, not revising

Remember that writing does not entail editing or checking references. You can do these things after you have written: that is called revising. Keep on writing and don't become distracted by small details and interruptions. If you need to make a brief note to check something, do so and then move on. You can edit and recheck your writing afterwards in another session. Keep the writing momentum going once you get started.

4 Start Well

As a postgraduate student, it is tempting to leave writing to one side while you perform experiments, engage in secondary research or analyse data. However, the longer you go without writing, the harder it is to get started. Avoidance habits can become unhelpful and repetitive and might lead to you feeling that you are stuck in a thesis-writing rut.

4.1 Write from the start of your graduate studies

It is necessary for all scientists to keep a daily written record of experiments, which is essential preparation for writing your thesis. Remember that, as a research student, it is your sole responsibility to start, write and complete your thesis. Therefore, you should also begin to think about, plan and start your thesis writing from the day your postgraduate study begins. Ensure that your laboratory notebook contains all of the information that you will need to write your thesis – if you are not sure, check with your supervisor. If you do not maintain an adequate laboratory notebook from the outset, it will be very difficult, if not impossible, to write your thesis. Writing is an integral part of the thinking process. It allows you to formulate and reflect upon your ideas; moreover, writing helps you to keep track of your progress and to record your development along the different stages of your research. If you leave all of your thesis writing to the end of your studies, the task of writing up will be much more difficult to achieve.

4.2 Write regularly

Do not wait until you feel 'ready' to write your thesis. Writing is a habit that you should get into from the start of your postgraduate studies. It is an essential part of your study, not a separate activity to be done after everything else has been completed. Therefore, integrate writing into your weekly routine. The more often you exercise the skill of writing, the more skilful you will become: practice makes perfect!

4.3 Write in brief bursts

Often, trying to sit down for long periods of time to write large amounts of text can be intimidating and off-putting. Break big tasks down into smaller chunks and attack them with vigour in short, timed writing sessions. Set yourself a time deadline which you aim to hit when you sit down to write. Doing this helps you to maintain concentration and motivation on the task in hand.

4.4 Leave time for writing

Do not spend time revising, editing, reading or formatting in your writing time. These activities are important but they should be done at another time. Writing means putting new words on the computer screen or page. Focusing on creating new text frees your mind from the constraints of trying to write accurately and precisely at the first attempt. Getting your initial ideas down on paper (or computer screen) quickly and then going back over them to revise and edit your work is a good way to make progress with your thesis. It is particularly useful in scientific writing to reference as you write.

4.5 Overcoming writer's block

You will not be able to write the perfect text straight away - no one can! Think of the writing process as a series of drafts not as a single attempt. The first draft will be rough work, with ideas jotted down, notes added here and there and ideas all jumbled up. However, after you have revised and rewritten this rough draft a few times, it will start to take shape and become a more polished version that is ready for submission.

All writers suffer from blocks at some stage. It is a normal part of the process of writing. Sometimes, your ideas might seem to be stuck in your mind; it is common to feel that you are going round in circles and not making any progress. There may also be times when it is so long since you started an experiment, or thought about a particular section of your thesis, that you have forgotten many important points and will need to do a lot of revising to bring yourself back to the point of being able to write anything about it.

Whatever the nature of the block that is stopping you from writing, there are ways to overcome it:

- Relax.
- Plan your way out of the block – try jotting down thoughts and ideas on a page and then putting them in order. Then add a list of the necessary resources next to each point.
- Try some of the methods outlined below and attack the writing task again, with renewed vigour.

It is important to free up your mind if you are experiencing a block. One method is to take a step back from the writing and create a diagram or mind map of what you are writing, containing only the key points. Then, start to build up the detail on the diagram/mind map by jotting in relevant information. Soon, you will have freed your mind from any clutter surrounding the task and renewed your comprehension of it, thus improving your confidence and allowing you to get back to writing.

Another useful approach is to work on tables/figures first and then structure your writing around these.

Another useful thing to remember is that writing is drafting. Write as briskly as you can, in the knowledge that you will be able to revise and edit your work at a later stage.

In *The Postgraduate Research Handbook* (2008, pp. 300-1), Gina Wisker provides helpful advice about how to overcome writer's block:

- brainstorm initial ideas without having to express them perfectly
- get out of a writer's block by doing some writing – the physical act
- work through psychological, intellectual or emotional responses
- open up ideas by writing them down
- get ideas and expressions circulating in your head down on paper so that you move on
- gain confidence by writing – producing an *amount* to be edited later by articulating ideas and arguments in your head, however (initially) poorly
- avoid using halting, formalised phrases and getting tied up in them, thereby *saying* nothing.

If you still feel that you need to talk to someone about writer's block, make contact with your supervisor and explain your situation. It would be a good idea to bring along relevant notes to the meeting as well as a list of the techniques that you have tried in order to overcome the block.

4.6 Acting on feedback and revising your text

Colleagues and supervisors may provide you with helpful feedback on your text. Redraft your writing in light of this advice and do so while the suggestions are still fresh in your mind.

Writing a successful thesis is not one, single inspired act. Instead, it should be viewed as a multi-stage process. You will not write your thesis out in one go and then submit it; there will be numerous stages of reflection, revision and rewriting to go through before you are ready to hand in your finished text.

Creating a first draft helps you to have something tangible to work on. Even if your thoughts and their expression are still in a rough form, and the text is not organized effectively, a first draft allows you to begin working on your ideas and reshaping them in order to meet the required standard for submission. Remember also that there is no single best way to write something in a thesis (or any other type of text). Progressing from a rough version of your thoughts to a superior and workable text takes time, effort, different perspectives and some expertise. Some useful tips on how to develop your first draft into a more polished version of academic writing are provided below.

- Print out your draft. Working with a hard copy should assist you in viewing the text from a different perspective; moreover, it should allow you to see where any chunks of text or paragraphs need to be moved around.
- Perform a close edit of your text. Make it 'clean' by getting rid of all spelling, grammatical, punctuation and typographical errors. Check also for any signs that you are repeating certain words too often: most authors have 'favourite' words or phrases which are in danger of being overused. Ridding your text of errors allows you to look beyond these details to the deeper intellectual matters you are handling.
- Check that the paragraphs you have devised are linked to one another in a coherent and cohesive manner. A chapter, for example, should be presented as a unified whole which has a stream of inter-connected paragraphs as its building blocks.
- Consider whether any of the arguments you have made in a chapter could be made stronger by the addition of more scholarly supporting material or empirical evidence.
- Take a break away from the text. For example, take a weekend off and then see how the text reads on Monday.
- When you receive feedback from your supervisor, it is a good idea to make any alterations that you deem necessary as soon as possible while they are still fresh in your mind.

4.7 Maintaining a positive approach to writing

Have a positive approach to writing. Do not be afraid of the writing process. To be a research student you have already completed an undergraduate programme, which included some scientific writing, with distinction. Approach writing with vigour and enthusiasm: learn from mistakes and keep moving forward. You will find that the more often you write, the easier it becomes!

5 Establishing Important Ground Rules with your Supervisor

The role of your supervisor is to guide you through the various stages of your research study and, ultimately, assist you in writing your thesis. It is important to remember that supervisors are busy professionals and that, although your thesis is probably the most significant thing happening to you in your academic career, you are only one of a number of students that your supervisor has to support. Therefore, your supervisor will not be able to chase you constantly to ensure that you are adhering to your study timetable.

In order to make the best possible use of your supervisor's experience, expertise and time, it is essential to prepare for your meetings. This is especially important for the first meeting you have with your supervisor, because it is at this juncture that you can establish some key points which will underpin the way you approach writing your thesis. At the outset, arrange a regular series of meetings with your supervisor during the write-up period (e.g. weekly).

Some useful issues to establish with your supervisor before you begin to write your thesis include:

Table 5.1 Broad issues to discuss with supervisor at start of writing process

Issue	Tick Box
Timetable for completion of stages of thesis	☐
Theoretical/conceptual framework of thesis	☐
Potential sources of evidence/further reading	☐
Research questions and design of thesis	☐
Statement of research contribution	☐
Methodology	☐
Analytical techniques for interpreting data	☐
Draft set of contents	☐

Remember also, that your supervisor wants you to do well; however, you can make their task of helping and supporting you significantly easier if you are clear about exactly what type of support you need and which answers you require. You are likely to create a good impression with your supervisor if you provide him/her with a clear outline of your thesis or a plan of action which summarises how you intend to go about the process of research. You should only submit your very best draft to your supervisor. By giving your supervisor this information, you are demonstrating initiative and diligence whilst also acknowledging the need of their expertise, experience and support.

The onus is on you, the student, to ensure that you have accurate, up-to-date information about the formatting and style, as well as the presentation, of your writing. You should use the *University Guidelines for Research Degree Programmes:* http://www.nuigalway.ie/media/graduatestudies/files/university_guidelines_for_research_degree_programmes.pdf to check the correct procedures with your supervisor at the start of your studies. Your supervisor can assist you with understanding the guidelines; however, it is your responsibility to follow the prescribed set of rules in terms of preparation and submission of written work.

Table 5.2 Matters of style to discuss with supervisor

Issue to Discuss	Tick Box
Typography – font style, size and spacing – 1.5 or double for drafts?	☐
Style guide – which one is recommended to follow?	☐
Formatting – headings and subheadings	☐
Presentation of illustrations	☐

Ask sensible questions of your supervisor. Many of the answers to your questions can be found in the *University Guidelines for Research Degree Programmes*; however, if you cannot find an answer there, your supervisor may be able to guide you in the right direction. The general rule for asking questions is: attempt to discover the answer yourself first. If you cannot find the answer, and you have exhausted all possible avenues, then your supervisor is there to help you. Finally, make your questions specific and precise so that your supervisor knows exactly how to guide you.

6 Organisation: The Layout of a Scientific-Style Thesis

Effective organisation is crucial to writing a clear, interesting and successful thesis. Such organisation includes following the prescribed format for a scientific-style thesis.

Masters' and PhD theses differ in a number of ways, as do expectations between different research degree programmes, even if they are in the same discipline. You will probably find that specific requirements are provided by the programme, School or College you are working in. As you begin your postgraduate studies, discuss matters of format and structure with your supervisor; also, look at some theses that have been written in recent years by successful students in your research group or School. Get a feel for how a thesis should be presented and use these models as examples for structuring your own study.

PhD and MD theses may be presented for examination as either a monograph or in an article-based format. Masters' theses are presented as monographs.

Both the monograph and article-based formats are equally valued and both are subject to the same examination process and must meet the same academic standard. The article-based format has both advantages and disadvantages. The advantages include wider and earlier dissemination of research results, and experience for the student in writing research articles. The disadvantages include the time delay in acceptance of articles by journal publishers in some research fields and the strict restriction on the length of research articles. A monograph has the advantage of more readily supporting the development of a sustained argument and maintaining focus on the overarching research question.

It is important that you agree the format of your PhD/MD thesis, i.e. monograph or article-based, with your supervisor. It may be necessary to reconsider the preferred format during your research degree programme as your research and attempts to publish it progress. You are advised to carefully consider the best format for the research, so that the thesis is completed in good time, taking into account the dissemination advantages of the article-based format.

6.1 University Guidelines for Research Degree Programmes

First of all, it is important to take note of the *University Guidelines for Research Degree Programmes* on the Graduate Studies website: http://www.nuigalway.ie/media/graduatestudies/files/university_guidelines_for_research_degree_programmes.pdf.When you are finishing your dissertation, you will need to make sure that all of the required sections for your Abstract, Acknowledgements, Appendices, Declarations and other supplementary material are presented in accordance with University guidelines.

6.2 Main sections of a scientific-style thesis

Before you begin to write your thesis, it is useful to know that there are certain key sections in the layout of a monograph format thesis. The format can be viewed as reasonably flexible. Your supervisor may advise you to adapt or amend this basic structure; nevertheless, the following list provides a general guideline for the design of the main body of text in your thesis.

Table 6.1 Outline of main body of a scientific-style thesis*

Introduction (including Literature Review)	Includes the justification for your research, the hypothesis behind the study and an explicit statement of your objectives. A detailed account of scholarly work that has already been done on your chosen subject.
Materials and Methods	An account of the procedures and techniques used in your research.
Results	A presentation of the data obtained from your research.
Discussion	An explanation of the significance of your findings and how they relate to the work of other scholars. A review of your findings and their importance as well as suggestions for further research in your chosen area.
Bibliography/ References	A full account of all literature used and cited in your thesis.

*The order of these sections may differ in some disciplines.

6.2.1 Introduction (including Literature Review)

- Provide background for the material to follow.
- Set up the main hypothesis which gives a rational argument explaining the motivation for performing the series of experiments that follow.
- Make the purpose of the thesis clear to readers from the beginning.
- Give a specific statement of the objectives of your research.
- The Literature Review, which forms part of the Introduction, acts as a foundation for the core section of your thesis.
- Cover all of the literature leading to the development of the hypothesis for each of your experiments.
- Make sure that all material in the Literature Review has a clear purpose: to develop arguments that will be used in the experiments you describe later in your thesis.

6.2.2 Materials and Methods

- Often, a thesis describes several experiments that have certain features in common. Usually, they have in common most of the 'materials', such as types of soil or population of patients or chemicals. It is good practice to include a Materials and Methods chapter that explains the materials and procedures used in most of the experiments you have performed, thus avoiding unnecessary repetition.
- Consider writing this section of the thesis first: it is the most straightforward and doing so should get you off to a good, solid start.
- Provide full details of your methodology so that another scientist could repeat your experiments.
- Give information that allows readers to judge whether the experimental methods are suitable and, as a consequence, whether the validity of the findings is acceptable.
- Any experimental plants, animals or microorganisms should be identified precisely, by genus, species and strain designation.

- Special characteristics such as sex, age, and genetic status should be explained and sources should be listed.
- Related methods should be described together.
- Do not put any results in this section.
- Use precise, accurate words and terms to describe the materials and methods.

6.2.3 Results

- The core of your thesis - the data.
- May be one or more chapters.
- Usually, results are presented in the past tense.
- State the results clearly and simply: they are what you are contributing to the field of knowledge.
- Each chapter can follow the same format as most research articles: Introduction, Materials and Methods, Results and Discussion.
- A short Introduction to this section builds on and extends the arguments already made in the review and offers a specific hypothesis for the experiment.
- Specific information on materials and methods for this chapter's particular experiment is also provided. This information is usually about the unique procedure for this experiment.
- Results are provided in full, with any non-essential data being placed in the Appendices.

6.2.4 Discussion

- Return to the original, main hypothesis.
- Provide discussion based on all of the results: do they support or reject the hypothesis?
- Compare results between experiments.
- Integrate experiments with each other.
- Describe the principal results that led to your conclusions but avoid recapitulating the results in detail – discuss them.
- Identify any exceptions or any lack of correlation. Do not try to cover these up; deal with them openly.
- Comment on any potential practical applications of your work.
- Consider the theoretical implications of your research.
- Highlight the main points of the thesis.
- Summarise the major findings of the thesis and explain their significance.
- Provide a statement of acceptance or rejection of your unifying thesis.
- Summarise the evidence for each conclusion you make.

6.2.5 Bibliography/references

The Bibliography is the last part of your thesis. Check with your supervisor about the correct system of citation and referencing to use in your thesis. For more information on citation practice, refer to section 9.0 of this guide. There are a variety of programs available to organise your references, such as EndNote. The 'cite while you write' tool is particularly useful for keeping track of references and maintaining an up to date bibliography. The library provides online guides on how to use EndNote: http://libguides.library.nuigalway.ie/EndNote.

6.3 Article-based format thesis

The article-based format thesis is based on a number of research articles (either published or accepted for publication) which describe a coherent programme of research undertaken by the student while registered for the PhD/MD.

The thesis must have a comprehensive introductory chapter, containing a review of the relevant literature and an explanation of the overall research question.

The thesis must contain a description of how the research in each of the articles relates to the thesis's overall research question.

In the case of multi-author papers, the student's contribution to each article must be made explicit.

The concluding chapter should refer to how each of the objectives of the research were met in the articles included, and critically evaluate and discuss the results reported in each article.

A comprehensive Bibliography must also be included.

Supplementary appendices of the methodologies used may be necessary if sufficient detail is not included in the articles in the thesis to allow repetition of the research.

Precise guidelines on article-based format theses are available in all five Colleges of the University, and some Schools. In all cases, the minimum number of published research articles is specified in these guidelines. Please refer to relevant College webpages or contact your College's Vice Dean for Graduate Studies or College office for these guidelines.

All other guidelines regarding presentation (see section 2.5.2), other sections of the thesis (see section 6.4) etc. apply irrespective of the format of the submitted thesis.

6.4 Other important sections of the thesis

As well as the main sections outlined in 6.2 and 6.3 which form the structure of the main body of the thesis, there are also a number of important sections in a thesis which play key roles in its presentation. These sections are outlined below.

6.4.1 Title Page

- In creating a title page for your thesis, a good starting point is to consider the information set out in the *University Guidelines for Research Degree Programmes*: (http://www.nuigalway.ie/media/graduatestudies/files/university_guidelines_for_research_degree_programmes.pdf).

- There must be a title page which will have the following information:
  a. The full title of the thesis and the subtitle, if any.
  b. The total number of volumes if more than one and the number of the particular volume.
  c. The full name of the author, followed, if desired, by any qualifications and distinctions.
  d. The qualification for which the thesis is submitted.
  e. The name of the institution to which the thesis is submitted.
  f. The college, school, discipline or organisation in which the research was conducted.
  g. The month of the year of submission.
  h. The name of the Head of School/Discipline.
  i. The names of the supervisors of the research.
- The title should describe the content of the thesis accurately and concisely.

When you create a title for your thesis, remember that it is the first impression that people will have of your research. It may be read by thousands of people on secondary databases; however, only a few people may ever read the entire thesis itself. Therefore, you should take special care when composing your thesis title. Each word should be chosen with care and consideration and the structure of their association with each other must be handled carefully. One of the most common features of flawed titles is faulty word order (syntax).

A useful definition of a good thesis title is: the fewest possible words that adequately describe the contents. Bear in mind also that abstracting and indexing services depend on the accuracy of the title; the same is true for computer literature retrieval systems. Therefore, if your title is not worded effectively, your work might never reach its intended audience of fellow researchers.

Think carefully about the length of your title. If a title is too short, it is unhelpful to the reader. For example, *Studies on Gorillas* is too short. It does not explain what type of study the thesis is about. More usually, titles are too long. These titles often contain what can be termed 'waste words' – words which can be left out without compromising the effectiveness of the title. Often, these words appear at the start of overlong titles. Examples of 'waste words' include:

- 'A'
- 'An'
- 'The'.

Similarly, waste phrases such as these should be avoided:

- 'Investigations into'
- Studies on'
- 'Observations on'.

Apart from making a title seem overlong and cumbersome, such 'waste words' and redundant phrases are useless for indexing and bibliographical purposes.

Sometimes, titles can be too short because they are too general. Try to use specific terms in your title and be as precise as possible about what is under investigation. For example, a title that is too general and, therefore, meaningless could be: *Action of Antibiotics on Bacteria*. A more specific version of this title could be, for example: *Inhibition of Growth of Mycobacterium Tuberculosis by Amoxicillin*. Notice how the second title defines the precise

type of antibiotic and bacteria under consideration; moreover, note how the start of the title is more exact in terms of what type of action is being examined in the study. Thus, it is now common for scientists to state the genus, species and strain number of any organism mentioned in the title as well as specific labelling for enzymes, etc.

A crucial aspect of writing an effective title is that of word order. Take care when using the word 'using'. Misplacing this word can have serious consequences for the meaning of your title. For example: 'Suppression of Brucellosis in Cattle Using Complement-Fixation Techniques'. The cattle referred to in the above title certainly seem to be smart!

In general, think of your title as a label, not necessarily a sentence. The order and precise meaning of the words in a title are very important to a potential reader who is searching through a database or an indexing system such as MEDLINE or *Chemical Abstracts*. Do not include abbreviations or jargon in a thesis title. Avoiding such words and phrasing will make it easier for other researchers to find your thesis in an index.

6.4.2 Table of Contents

The *University Guidelines for Research Degree Programmes* states that: 'The Table of Contents should immediately follow the title page and not be overly-detailed.' The purpose of the Table of Contents is to provide a listing of the headings and sub-headings of the thesis, along with their corresponding page numbers.

Make sure that the Table of Contents is formatted correctly and also that the page numbers in the text of the thesis correspond with those on the table.

A useful facility on most word processors can help you to ensure accuracy and consistency regarding your Table of Contents. The 'Outline' mode of Microsoft Word allows you to organise a set of headings and subheadings of various levels. You decide on the headings, subheadings and their divisions and then assign them to various levels. Level 1 is for main headings, level 2 is used for subheadings, etc. These levels can be changed whenever you want during the writing process. Using this application allows you to create an automatic Table of Contents.

If you do not use the above feature of the word processor, you can devise your Table of Contents by following the set of instructions listed below.

- Decide the lowest level of heading to display on your Table of Contents (subheading? sub-subheading?). It is not recommended to use headings lower than sub-subheadings.
- Make a list of all the sections, headings and subheadings down to the lowest level on the left side of your page.
- Number the sections and headings /subheadings using the decimal point numbering system thus:

1.0 Title of First Main Section/Chapter

1.1 First subheading

1.2 Second subheading

2.0 Title of Second Main Section/Chapter

2.1 First subheading

2.2 Second subheading

2.2.1 First sub-subheading

2.2.2 Second sub-subheading

3.0 Title of Third Main Section/Chapter

- Make sure that any indentations are consistent for subheadings and sub-subheadings.
- Top level headings have full capitalization (each main word is capitalized). They are in bold type. For the other levels, use sentence case (first word is capitalized). Your supervisor may ask you to use a different system of capitalization, or headings, so check with him/her before you begin to organise your Table of Contents.
- Place corresponding page numbers on the right hand side of the page, using accepted conventions for page numbering. Page 1 is the first page of the main body of the thesis. All preliminary pages (Title Page, Abstract, Acknowledgements, Table of Contents, List of Illustrations, Glossary of Abbreviations, etc.) are given lower case Roman numerals (i, ii, iii, iv, v, etc.).
- Do not include lists of individual figures or tables in the Table of Contents. A separate section including a List of Figures and a List of Tables should be provided, which immediately follows the Table of Contents. The number, title and page of each table and figure should be provided.

6.4.3 Declaration regarding the work

You must certify that the thesis is all your own work and that you have not obtained a degree in NUI Galway, or elsewhere, on the basis of the work described in the thesis. If the thesis is based on a group project, then you must explicitly state the extent of your contribution, with reference to any other theses submitted or published by each collaborator in the project.

6.4.4 Abstract

An Abstract provides a summary of the thesis. The *University Guidelines for Research Degree Programmes* stipulates that an Abstract of no more than 300 words is required when submitting your thesis. A useful way to plan your Abstract is to think of it as a condensed version of the thesis in its entirety. It should provide a summary of the main sections of the thesis: the Introduction, Materials and Methods, Results and Discussion. An effective Abstract should allow readers to understand the basic content of a thesis quickly and precisely, so that they can judge whether it is relevant to their own research interests and, therefore, worthwhile reading the thesis itself. Pointing out the novelty of the work is important in this regard.

It is normal practice to present the Abstract as a single paragraph. In terms of organization, a useful plan to follow is:

- clarify the main objectives and scope of the research
- describe the methods employed
- provide a brief summary of the results
- outline the key conclusions.

Use the past tense when composing your Abstract – you are writing about what has been done. Do not include tables or graphs in the Abstract; also, references to literature should not be included.

Make sure that your Abstract does not contain any information that is not included in your thesis. Accuracy and precision are crucial to the success of an Abstract.

6.4.5 Acknowledgements

When composing the Acknowledgements section of your thesis, bear in mind that you must include two key components:

- Firstly, you should acknowledge any technical assistance you received during your research - in the laboratory or elsewhere. An example of such an acknowledgement is: 'Thanks are due to F. Cleary for assistance with cell culture and flow cytometry experiments and to G. Houser for valuable discussion.' Additionally, the source of any special material, cultures or equipment should be acknowledged.
- Secondly, use the Acknowledgements to refer to any external funding or financial assistance, such as fellowships, grants or contracts, which you have received during your postgraduate studies.

In general, be courteous and precise with the wording of your Acknowledgements. Say 'Thank you' to those who have helped you in your postgraduate research to show that you value the advice and support of your friends and colleagues.

6.4.6 List of Abbreviations/Glossary of Terms

Three basic rules govern the use of abbreviations in a thesis:

- Only use standard abbreviations
- Do not use abbreviations in the Abstract or the Title
- Do not use full stops with abbreviations except after 'no.', which might be misread without the full stop.
- When using an abbreviation for the first time, the full term for which it stands should precede the abbreviation in the text, followed by the abbreviation in parentheses. For example, 'Researchers at the World Health Organization (WHO) discovered that ....' In the remainder of the text, the abbreviation alone should be used. All such abbreviations should be included in a Glossary of Terms because readers sometimes have difficulty finding the first usage in the main text. Place the List of Abbreviations at the beginning of your thesis, immediately after the Table of Contents.

The List of Abbreviations is intended to define specialist abbreviations, symbols and terms that are used in your thesis. You must decide which terms require definition, such as specific technical words/phrases, Greek or other symbols, abbreviations (including acronyms such as WHO, ADHD), etc.

In a scientific-style thesis, it is also advisable (Silyn-Roberts, 2000, p. 27) to state the following information above your List of Abbreviations:

S.I. (Système International d'Unités) abbreviations for units and standard notations for chemical elements, formulae and chemical abbreviations are used in this work. Other abbreviations are listed below.

In general, it is wise to keep abbreviations to a minimum. Your work will be more attractive to readers if it is not cluttered with too many abbreviations.

When writing units of measurement, abbreviations may be used when the numerical value is given. For example, 7 mg was added. When numerals are not used, however, units of measurement should not be abbreviated.

6.4.7 Appendices

An Appendix is not an essential component of a thesis; however, it is a useful section in which to include material that is relevant to the main body of your thesis but not suitable for inclusion in it. Therefore, we can view an Appendix as a set of related items to the main body of a thesis. For example, Appendices may include:

- tables that are too detailed for presentation in text
- large groups of illustrations
- technical notes on methodology
- forms used in collecting materials/data
- copies of relevant documents
- illustrative materials such as figures.

All Appendices should go at the end of your thesis: sometimes they are referred to as 'back matter' for this reason.

To organise your Appendices correctly, you must place materials of different categories in separate Appendices. When there are numerous Appendices, each is given a number or a letter: Appendix 1 or Appendix A. Also, a clear title should be provided for each section of the Appendices. Check with your supervisor which is preferable in your case.

The page numbers used in the Appendices are separate from those of the main thesis and are to be presented as: A-1, A-2, A-3, etc.

7 Format

This section contains some helpful general information on thesis format and style. Specialist textbooks, such as those listed in the Bibliography to this manual, provide useful models. Remember to check the exact requirements with your supervisor and your school/college website so that you are working with the correct formatting style.

7.1 Headings and subheadings

The formatting of headings can vary from discipline to discipline. However, a general guide is provided below.

- Main headings (i.e. of chapters/main sections) should be in bold type.
- Subheadings and sub-subheadings should not be in bold type.
- Full capitalization is used for main headings such as section/chapter headings, e.g. 2.0 Materials and Methods.
- For the next levels down (subheadings and sub-subheadings), the first word is capitalized, e.g. 2.1 Volume data sets, 3.3.1 Dye concentration and fields.
- For headings of figures and tables, use capitals for the first word only, e.g. Figure 1 Incidence of hospital-acquired infections.
- The table number and title is placed above a table.
- The figure number and title is placed below a figure.

7.2 Font size and style

Refer to the advice given in the *University Guidelines for Research Degree Programmes*: (http://www.nuigalway.ie/media/graduatestudies/files/university_guidelines_for_research_degree_programmes.pdf) for the rules of font size, style and format. In general, a font such as Times New Roman .12 should be used.

7.3 Spacing

Check the *University Guidelines for Research Degree Programmes* for guidance. As a rule, you should present your work in either 1.5 or double spacing. You can verify which spacing your supervisor recommends at your initial meeting.

7.4 Illustrations

Before you use a figure or table in your thesis, make sure that it has a clear purpose. Think about what your readers require to help them to understand your text. Each figure or table should be self-contained: readers should not need to read the surrounding text in order to comprehend the information in the figure or table.

- Give each figure and table a number and an informative title. Use sentence case capitalization for the title (first word only), e.g. Figure 5.1. Incidence of hospital acquired infections. Figure numbering should be chapter specific, so figures in the introduction are numbered 1.1, 1.2, 1.3 etc. Tables should be numbered independently but taking a similar approach, so tables in the introduction are also numbered 1.1, 1.2, 1.3 etc.
- All figures and tables must be referred to in the text before they appear.
- Avoid abbreviations in figures and tables, where possible. If you need to use an abbreviation, provide a key in the figure/table itself.
- Use software packages to make your figures and tables look as professional as possible.

7.4.1 Figures/graphs

Figures present information in pictorial fashion. Consider whether the data you possess is best communicated through a figure. For example, if there is one curve on a graph, could you describe it in sentences to better effect? If you decide that a figure or table is necessary, you will then need to decide which type of illustration is appropriate: do you want to show your readers exact numerical values or a picture of the trend or pattern of the data?

Graphs should be used when the data shows definite trends which would create an interesting picture. Figure 7.1 is provided below as an example. Note that the figure number and title appear below the figure itself.

- Label the axes on each graph accurately and fully: what is being plotted and what are the units?
- In graphs always plot the independent variable on the X axis (and the dependent variable on the Y axis).
- Avoid presenting overcrowded graphs. Sometimes it is better to have two graphs rather than one that is congested.
- Ensure that each line on your graph is easily distinguishable from the others.

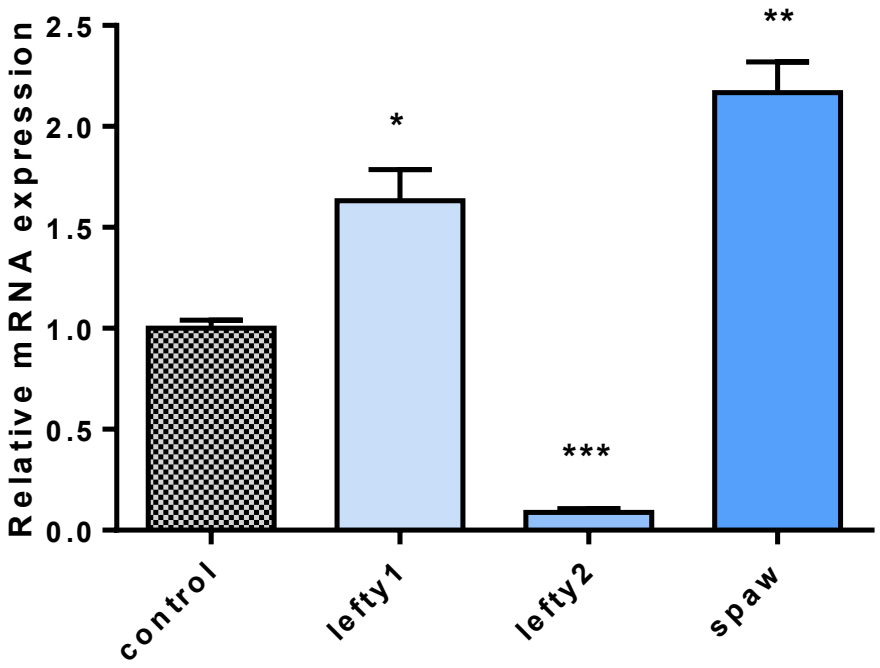

*Figure 2: The effect of the plakoglobin gr12345 mutation on Nodal gene expression in zebrafish embryos at the 18-somite stage. mRNA levels of nodal target genes lefty1, lefty2 and southpaw (spaw) were quantified by quantitative RTPCR. Data are mean ± sd. Data were analysed by one-way ANOVA followed by Tukey post-hoc test *P<0.05; ** P<0.01; ***P<0.001 vs control, n=3 per group.*

Figure 7.1 Example of a figure

7.4.2 Tables

Tables should be used when repetitive data need to be presented. Think carefully about whether the information you want to communicate could be presented in the text rather than in a table.

When you present numbers, provide significant figures only. Do not include non-essential data such as results of simple calculations.

Do not present the same data that you provide in a table (or a figure) in the text: needless repetition does not create a good impression with examiners.

When presenting data in a table, consider the following points:

- Decide whether it is best to present your information horizontally or vertically.
- Numbers in a column are lined up on the right.
- Words in a column are lined up on the left.
- Provide headings in the table that make the meaning of the data clear.
- If necessary, provide short, precise explanatory footnotes.
- Provide a concise, precise title for the table. Omit unnecessary words.

Table 1: Effect of the plakoglobin gr12345 mutation on heart-rate in zebrafish embryos at 48 and 72 hours post-fertilization (hpf).

Stage	Heart rate, beats per minute, mean ± sd		
	Wild-type	gr12345 heterozygous	gr12345 homozygous
48 hpf	145±3	120±8*	110±8**
72 hpf	155±4	126±5*	115±5**

*Data were analysed by one-way ANOVA followed by Tukey post-hoc test*P<0.05; ** P<0.01 vs control; n=10 per group.*

Figure 7.2 Example of a table

7.5 Numbers and numerals

There are numerous editorial conventions relating to the use of numbers and numerals in scientific writing. The list and table provided below outline the main rules to follow.

- Numbers one to nine should be written in full, e.g. one, two, three.
- Numerals should be used to express numbers 10 and larger e.g. 200, 550.
- In a graphical display, numerals should always be used.
- Numerals are used to express numbers below 10 that are grouped with numbers 10 and larger, e.g. 8 of 32 test cases.
- Numerals are used to express numbers preceding a unit of measurement, e.g. 7 kilometres, a 50 mg dose.
- Whenever you are recording mathematical or statistical data, fractions, decimals, ratios and percentages, numerals should be used, e.g. divided by 4, a 76% increase.
- Use numerals to express units of time, date, age, population or sample size, number of participants in a research study, points or scores on a scale and sums of money, e.g. in 4 years, 5.30 PM, December 25, 2009, £68 million.
- Numerals are used to express page numbers or parts of a table, graph or figure.
- If a sentence begins with a number, that number should be written in full, or the sentence should be rewritten so that the number does not begin it.

Table 7.1 Use of numbers and numerals in academic writing

Numbers	Convention	Examples
Measured quantities	Use numerals	Weights, distances, degrees, dimensions, decimal points. 4.7 seconds, £650, 9 tonnes, 24 kilometres.
Counted numbers	One to nine – use words 10 upwards – use numerals	One experiment... Seven of the respondents... Measurements were taken in 15 areas.
Mixed series of numbers which are greater than and less than ten	Use numerals	Observations were made over periods of 4, 8 and 12 hours.
Percentages	Use numerals	The results demonstrate that 10 per cent of sufferers experienced significant improvement.
Fractions	Use words	Approximately one quarter of the population was immune.
Dates and times	Use numerals	The experiment began on 23 January. The experiment ended at 11.35 am.
Figures and tables	Use numerals	Figure 7 shows that ...

8 Scientific Writing Style and Grammar: Guidelines

Clarity is the key feature of scientific writing. It is especially important when something is being communicated for the first time. As a thesis contributes new knowledge to the field, absolute clarity is required when writing a scientific-style thesis. Do not try to write elaborate sentences in order to impress your readers. Use a simple, precise style of writing to put your points across effectively and accurately.

The information provided in this section has been adapted from a number of the texts which are listed in the Bibliography to this guide. For further guidance on the grammatical rules outlined below, please refer to these texts which are available in the University library.

8.1 General points on style

Good grammar is necessary in all scientific writing. However, style may differ among disciplines. This section does not attempt to provide comprehensive guidelines on different academic writing styles; nevertheless, it covers some of the frequently asked questions about how to write correctly and accurately at postgraduate level.

8.1.1 Sentences and vocabulary

- In general, use short, clear, declarative sentences. They are easy to understand and straight to the point.
- Nevertheless, bear in mind that too many short sentences placed together can make your text seem abrupt or dull. Mix up the length and complexity of your sentences to avoid presenting your text as monotonous and fragmented.
- Use linking words (conjunctions) to help readers to see how your argument is building up to its conclusions. Words such as: 'moreover', 'additionally' and 'furthermore' are useful when joining two clauses together which agree with each other. Conjunctions such as: 'however', 'yet', nevertheless', 'notwithstanding' and 'still' are helpful in linking two clauses which disagree.
- Remember that a full stop or semi-colon needs to be placed before these linking words if you are connecting two independent clauses – not a comma. It is incorrect grammar to splice two sentences/independent clauses together using a comma. For example, it is incorrect to write: 'Mice have often been used for biological research, however, there are several other suitable mammals which could be used instead.' The correct punctuation in this sentence would be to replace the comma before 'however' with a semi-colon or full stop.
- Scientific writing should be precise and unambiguous. Be careful when using words that you are doing so accurately; for example, do not use 'while' if you mean 'although', or 'since' if you mean 'because'.
- For clarity, keep using the same word to describe the same thing. Do not vary your vocabulary in scientific writing as you might in a literary composition. For example, if you are writing about mice, write 'mice'. Do not change this word to 'rodents' or 'animals' as you write your text. Keep a high level of consistency with your vocabulary so that your readers do not become confused.

8.1.2 Paragraphing

Paragraphs are the written units of your thought about something. The way that you organize them into a pattern is an important factor in making your argument look logical and well-ordered. As a general rule, a paragraph should make one point – that is the thought you are thinking as you write it. Readers will expect each paragraph to have a particular point to make; furthermore, they will be expecting each paragraph to be linked in some way with those before and after it.

The length of your paragraphs is also important. Paragraphs that are too long present your writing as under-organized and hard to follow. On the other hand, thesis paragraphs that are too short make your text look disjointed, bitty and superficial, implying that you have not developed your points enough. A helpful suggestion is to aim for a paragraph length between 100 and 200 words. This should take up roughly a third to two-thirds of a page of A4 paper, typed double-spaced.

When writing your paragraphs, think about the order of the material you are presenting. Usually, the academic paragraph follows this sequence:

Topic

↓

Main Body

↓

Wrap up.

The first sentence of your paragraph is sometimes called the 'topic sentence'. It introduces readers to the focus, or point, of the paragraph.

The main body of the paragraph follows the topic sentence and provides elaboration, evidence, analysis, examples and reasoning.

Finally, the wrap up sentence gives a mini-conclusion for the paragraph, summing up its main message. This is a useful formula to stick to throughout your thesis.

8.1.3 Verb tenses

- When stating what has been done, use the simple past tense. For example, 'The injection was administered.' Alternatively, 'Smith reviewed the work of Black and concluded that ...'
- Use the present tense for statements of fact, such as: 'Developmental biology is the study of the growth of an organism.'

8.1.4 Double negatives

- Do not use double negatives. Instead, write affirmative sentences. See the chart below for some examples.

Table 8.1 How to avoid using double negatives

Double negative	Replace with
This result is not uncommon.	This result is common. This result occurs 65% of the time.
This reaction is not unlikely to occur.	This reaction is likely to occur. This reaction is possible.
This method is not infrequently used.	This method is frequently used.

8.1.5 Only

- Be careful when using 'only'. It means different things when placed in different places in sentences.

Table 8.2 Different usages of the word 'only'

Usage/Placement	Meaning
Only the smallest group was injected with the drug.	no other group.
The smallest group was only injected with the drug.	not given the drug in any other way
The smallest group was injected with the only drug.	no other drugs

8.1.6 To comprise

- 'To comprise' means 'to consist of' or 'to contain'.
- It should not be used instead of 'to compose'.
- Do not write 'is comprised of': it is incorrect to do so.

Table 8.3 Usage of 'to comprise'

Correct	Incorrect
A thesis comprises several chapters.	A thesis is comprised of several chapters.
The project comprised three stages.	The project was comprised of three stages.

8.1.7 Abbreviations

- In general, avoid abbreviations except for standard units of measurement and their Système International (SI) prefixes.
- If you do intend to use an abbreviation, you should introduce it by writing the word or term out in full first, followed by its abbreviation in parentheses.
- Abbreviate units of measurement when they are used with numerical measurement. For example, '6 mg was added'. However, when numerals do not accompany them, units of measurement should not be abbreviated.

- Do not start sentences with an abbreviation.
- Refer to section 6.4.6 of this manual for more information on abbreviations.

8.2 Commonly confused words and phrases

This section deals with some examples of words and phrases that are commonly confused and misused. It is important to check your work against the lists provided to ensure the accuracy of your grammar and expression.

8.2.1 There/their/they're

These words are homophones, meaning they sound the same when spoken. However, they mean different things.

Table 8.4 Usage of 'there' / 'their' / 'they're'

Word	Usage rule	Example
There	Two uses: • Refers to a place • Used with the verb 'to be'	The infection was not there. There were 17 respondents to the survey.
Their	Belonging to them	Their blood sugar levels were raised.
They're	Shortened form of 'they are'. Do not use in academic writing.	They're not interested in the results.

8.2.2 This/that

- These words are pronouns: they are used instead of nouns to make writing less repetitive.
- Be sure that there is no ambiguity when you use 'this' or 'that'.
- If the meaning is unclear, use a noun after the pronoun to clarify it for readers.

Table 8.5 Avoiding ambiguity: usage of 'this'/'that'

Unclear/Ambiguous	Clear/Unambiguous
The impact of erosion on the coastline of Ireland has been the focus of numerous investigations. This is due to a number of factors.	The impact of erosion on the coastline of Ireland has been the focus of numerous investigations. This interest is due to a number of factors.
The use of penicillin has been a major factor in the decrease in infant mortality rates in Europe. This is most noticeable in Spain.	The use of penicillin has been a major factor in the decrease in infant mortality rates in Europe. This reduction is most noticeable in Spain.

8.2.3 Greater than/more than

- Use 'greater than' or 'more than' instead of 'in excess of' or 'over'. It is more precise to do so.

Table 8.6 Usage of 'greater than'/'more than'

Recommended	Avoid
greater than 75%	in excess of 75%
more than 50 mg	over 50 mg *or* in excess of 50 mg
more than 300 samples	over 300 samples *or* in excess of 300 samples

8.2.4 Fewer/less

- Fewer is used to refer to number.
- Less is used to refer to quantity.

Table 8.7 Usage of 'fewer / 'less'

Fewer – number	Less – quantity
fewer than 60 samples	less evidence
fewer than 100 species	less material
fewer than 30 experiments	less work
fewer than 50 types	less diversity

The exception to the rule is to use 'less' with number and unit of measure combinations because they are deemed to be singular. For example, 'less than 10 mg' and 'less than 24 hours'.

8.2.5 Among/between

- Use 'among' for three or more named or implied objects in a sentence.
- Use 'between' for two named objects in a sentence.

Table 8.8 Usage of 'among' / 'between'

Among	Between
Collaboration among scientists would be beneficial to the project.	Collaboration between biologists and physicists would be beneficial to the project.

8.2.6 Assure/ensure/insure

- Assure means to affirm.
- Ensure means to make certain or guarantee.
- Insure means to indemnify or underwrite for money.
- Be careful not to confuse these three words.

Table 8.9 Usage of 'assure' / 'ensure' / insure'

Assure	Ensure	Insure
They assured me that the experiment was a success.	This particular method ensures the reliability of the findings.	You need to insure your car.
She assured me that the project would be completed on time.	Care was taken to ensure the anonymity of the participants.	It is prudent to insure your belongings.

8.2.7 Affect/effect/impact

- Choose these words carefully: they mean different things.
- 'Affect' is a verb. It means to change, modify or influence.
- 'Effect' can be used as a verb or a noun. As a noun, it means result, outcome or consequence. As a verb it means to bring about or cause.
- 'Impact' is a noun. It is used to refer to a significant or important effect.

Table 8.10 Usage of 'affect' / effect' / 'impact'

Affect	Effect	Impact
The chemical solution did not affect the acidity of the water in any significant way.	The effect of the chemical solution on the plankton was minimal.	The impact of penicillin in the fight against infection has been felt throughout the world.
The use of fossil fuels affects the ozone layer.	The use of fossil fuels has an effect on the ozone layer.	The impact of global warming on Ireland's economy is significant.

8.2.8 With / to - comparisons

- When you use 'compare' in a sentence to note similarities, use 'to' after it.
- When you use 'compare' to note differences, use 'with' after it.

Table 8.11 Usage of 'with' / 'to'

Similarity – to	Contrast – with
Compared to patient 3, patient 4 displayed similar symptoms.	Compared with patient 2, patient 5 displayed different symptoms.
Compared to Smith's study, Jones' research produced corresponding results.	Compared with Smith's study, Jones' research produced conflicting results.

8.2.9 Pour / pore / poor and other commonly confused words

Table 8.12 Usage of 'pour' / 'pore' / 'poor'

Word	Usage	Example
Pour	Remove some or all of the contents (usually liquid) of a container by tipping the container.	The contents of the beaker were poured into the dish.
Pore	Small hole or dimple in a surface, e.g. skin.	The pores of her skin allowed her to remain cool.
Poor	Suffering from insufficient resources (usually money).	He was poor but happy.

Table 8.13 Other commonly confused words

Word	Meaning
Complement	that which makes up or completes
Compliment	praise
Dependant (noun)	one who depends on another
Dependent (adjective)	depending on
It's	it is or it has
Its	belonging to it
Principal	chief, most important
principle (noun)	truth, law, idea; code of conduct
Respectable	worthy of respect
Respectful	showing respect
Respective	relating to each in order

(Source used: Temple, 1997)

8.3 Academic tone

The main purpose of academic writing is to communicate ideas and arguments in a form that is economical and clear. This section deals with some important rules to follow in order to ensure your writing has an appropriate academic tone.

8.3.1 Jargon and slang

- Avoid using jargon and slang in academic writing.
- Use precise, accurate words and expressions instead.

Heather Silyn-Roberts (2000, p. 221) provides a useful list of jargon/slang phrases to avoid. Some of them are listed below.

Jargon/slang phrases to avoid		
a window of opportunity	all things being equal	at this point in time
as a matter of fact	at the end of the day	effective and efficient
conspicuous by its absence	easier said than done	in the long run
if and when	in the foreseeable future	last but not least
in the matter of	it stands to reason	needless to say
level playing field	many and diverse	slowly but surely
on the right track	par for the course	
the bottom line	as a last resort	

8.3.2 Brevity

- Keep your writing clear, simple and direct.
- Wordiness obscures your meaning and irritates your readers.

Table 8.14 Wordy phrases to avoid

It may be thought that
It may be said that
It has been found that
It is interesting to note that
It was demonstrated that
It is worth mentioning/noting at this point that
As already stated
It has long been known that

(Adapted from Dodd, 1986)

In scientific theses it is necessary to accurately and precisely describe experiments and analyses, rather than describing the methodology in general. For example, it is necessary to write 'Data were analysed by two-way ANOVA followed by Tukey's post-hoc text' rather than 'Statistical analyses were carried out.' Similarly 'The 372 base pair mouse growth hormone cDNA fragment was amplified by PCR' is preferred to 'PCR was performed'.

- Be concise – omit excess words.

Table 8.15 How to omit excess words

Wordy	Concise
These findings are preliminary in nature.	These findings are preliminary.
There are five factors which should be considered.	Five factors should be considered.
This is a dilemma that is ...	This dilemma is ...
It is a technique that is often used.	This technique is often used.

To make your writing succinct, use single words instead of phrases.

Table 8.16 Succinct writing

Wordy	Succinct
a number of	many, several
a small number of	a few
are in agreement	agree
are found to be	are
are known to be	are
at present	now
at the present time	now
based on the fact that	because
by means of	by
despite the fact that	although
due to the fact that	because
during that time	while
fewer in number	fewer
for the reason that	because
has been shown to be	is
if it is to be assumed that	if
in colour, e.g. red in colour	just state the colour, e.g. red
in consequence of this fact	therefore, consequently
in length	long
in order to	to
in shape, e.g. round in shape	just state the shape, e.g. round
in size, e.g. small in size	just state the size, e.g. small
in spite of the fact that	although
in the case of ...	in ..., for ...
in the near future	soon
in view of the fact that	because
is known to be	is
it appears that	apparently
of great importance	important

Wordy	Succinct
on the order of	about
owing to the fact that	because
prior to	before
reported in the literature	reported
subsequent to	after

(Source: Dodd, 1986)

8.3.3 Contractions

- Do not use contractions in academic writing

Table 8.17 Contractions

Inappropriate	Appropriate
Isn't	Is not
Couldn't	Could not
Won't	Will not
It's	It is

8.3.4 Gender-neutral language

- Recent academic writing style guides encourage writers to choose terms that do not emphasize outdated gender roles.
- Aim to write in an unbiased, gender-neutral style. Whichever method you adopt, be consistent with its use throughout your thesis.
- Instead of 'man', use 'humans' or 'people'.
- See Dodd for more information and useful examples. The tables provided below are adapted from this source.

Table 8.18 Gender-neutral language

Outdated	Gender-neutral
The effects of the serum were examined in mice and man.	The effects of the serum were examined in mice and humans.
Men suffering from skin disorders are often unaware of the treatments available.	People suffering from skin disorders are often unaware of the treatments available.
Man's search for a cure for the common cold ...	The search for a cure for the common cold ...

Some specific words have become outdated and can be substituted by gender-neutral terms

Table 8.19 Outdated terms and their gender-neutral equivalents

Outdated	Gender-neutral
Manpower	workers, staff, workforce, labour, crew, employees, personnel
Manmade	synthetic, artificial, built, constructed, manufactured

'They' and 'their' can be used instead of 'he 'and 'his'. Alternatively, use 'a' or 'the', or leave the pronoun out altogether.

Table 8.20 How to avoid misusing 'his'

Outdated	Gender-neutral
The head of department should lead his team effectively.	Heads of departments should lead their teams effectively. The team of a head of department should be led effectively. The head of department should be an effective team leader.

8.4 Grammar

Many students claim that they are unsure about grammar. This section aims to provide a general guide to some of the rules governing language use. It does not give a complete set of grammatical rules but should give you enough information to get started. Accurate grammar is important because it is an essential and expected component of postgraduate academic writing – without it, your text may not make complete sense or it may be ambiguous in a way that detracts from its overall quality.

In general, you should try to be as accurate as possible with your use of grammar. Identify the errors you make and make an effort to understand why you were wrong and why the corrections should be made. Keep a checklist of the mistakes you make and form a habit of consulting reference works as well as using electronic grammar checkers in order to maintain a consistently accurate approach to academic writing.

8.4.1 Comparisons

Confusion over using comparisons often occurs in students' work, particularly with words ending in –er and –est and the words 'more' and 'most'. For example: The bruising on Patient A was *more darker* than that on Patient B. This should be written thus: Patient A's bruising was darker than Patient B's. Another example is: There were less cases of dysentery than last year. This should be: There were fewer cases of dysentery than last year (countable). If the amount is not countable (for example, rainfall, you would use 'less' instead of 'fewer': There was less rainfall than in 2007.

8.4.2 Commas

Using commas when describing can also confuse some writers. Commas can change the meaning of sentences dramatically. For example: Dogs, which are dangerous, should be kept in secure enclosures. (The implication is that all dogs are dangerous.) This should perhaps read thus: Dogs which are dangerous should be kept in secure enclosures. (The inference in this case is that only those dogs which are dangerous should be in secure enclosures.)

8.4.3 Encapsulating

Encapsulating is where a single word is used to refer to a previous word or idea. For example: Many factors have an impact on water quality in lakes. This increases during summer months. (The inference is that water quality in lakes increases during the summer months.) The sentences should read: Many factors have an impact on water quality in lakes. This impact increases during the summer months. Another example is: Plakoglobin is a desmosomal protein. Plakoglobin links A to B. The second sentence should read: It links A to B.

8.4.4 Connecting words

Connecting words such as 'because', 'but' and 'and' are called conjunctions. They are used to join two clauses; they should not be used to begin sentences.

8.4.5 Prepositions

Prepositions should not be placed at the end of sentences. For example: These statistics are the only ones we work with. This sentence should read: These statistics are the only ones with which we work.

8.4.6 Pronouns

Pronouns need to agree with the verb in the sentence. For example: Each of the laws were passed by the government. This should read: Each of the laws was passed by the government.

8.5 Common errors

Some of the more common punctuation errors are dealt with in this section. It is a good idea to check your writing for punctuation mistakes before you submit it to your supervisor for feedback. Keep a log of the mistakes you make and concentrate on correcting them in the next piece of writing you give to your supervisor.

8.5.1 Exclamation marks

Do not use exclamation marks in academic writing. In general, it is rare that there is a need to use exclamation marks in your thesis. If you find yourself doing so, simply replace them with full stops.

8.5.2 Overuse of parentheses

Overusing parentheses is another problem. Use commas instead or ask yourself whether the information within the parentheses is really important enough to include in your text.

8.5.3 Run-on sentences - misuse of commas

Do not use a comma to join two independent clauses. This is incorrect grammar. Two sentences cannot be joined by a comma. This mistake is often referred to as a comma splice. You should use a full stop, semi colon or colon to join two independent clauses instead. It is incorrect, for example, to write: The war had ended, a peace treaty has been signed. The correct way to write this would be to replace the comma with a full stop, colon or a semi colon.

8.6 Punctuation

It is a good idea to read published work in your discipline in order to note how punctuation is used. Pick up some tips from professional writers and try them out in your own work. If you feel that your use of punctuation is weak, you may want to invest in a specialist guide book in order to have a handy reference text while you are writing your thesis. For suggestions on suitable reference books, see the Bibliography of this guide.

Correct punctuation helps readers to understand your message. If you misuse it, or pay no heed to it, your work will be confusing for readers. Furthermore, it is surprising to what extent punctuation mistakes can leave a poor impression of your academic ability. It would be a real shame to lose favour with readers of your thesis because of inaccurate punctuation. This section provides some general guidance about the rules of punctuation. Learning how to punctuate correctly will contribute to your skill as an academic writer and help you to become the author of a successful thesis.

8.6.1 Alphabetical list of punctuation

See F. O'Shea, (2004) *Up With Which I Will Not Put: Writing Skills for Students.* Cork: UCC, as well as other apposite texts listed in the Bibliography for more guidance on punctuation. The information provided below has been adapted from a number of sources, including K. McMillan, & J. Weyers (2007) *How to Write Essays and Assignments.* Essex: Pearson.

Apostrophe (')

This mark is used for possession: for example, Hitler's policy (singular), or the flowers' pollen (plural). It is also used for contraction, such as don't, shouldn't, I'm. Remember that contractions should not be used in academic writing: they are too informal. Therefore, as a general rule of thumb, you should only need to use apostrophes for possession in your thesis. Note also that no apostrophe is required for the possessive form of its.

Brackets (parenthesis)

Square brackets [...] are used when adding your own words within a quotation.
Round brackets (...) are used to separate illustrative information from your main text.

Capital Letters (ABC)

These are used to begin sentences, proper nouns, seasons, rivers, mountain ranges, acts of parliament, titles and organizations.

Chemical elements are not proper nouns; therefore, do not capitalize them. Only the first letter of the symbol is a capital letter: carbon (C), calcium (Ca).

Scientific names, consisting of genus and species, should be underlined or italicized. The genus should be capitalized: *Homo sapiens*.

Colon (:)

- Used to introduce a list, for example: The main types of bandage are: tubular, crepe and elastic.
- Used to introduce a long quotation.
- Used to move from one clause to another in a sentence, particularly when some powerful evidence or statement follows it. For example: Punctuation is important: it can be the key factor in successful academic writing.

Comma (,)

A comma has a variety of uses:

- Separating items in a list of three or more. For example: bacon, sausage, beans and egg.
- Separating different parts of a sentence. For example: She ran home, washed and went back out again.
- Separating sub-ordinate clauses (additional information) in a sentence.
  For example: Red meat, eaten in moderation, is beneficial to human health.
- Marking adverbs at the start of sentences. For example: Certainly, the methodology was problematic.

Dash (-)

- Can be used to mark an addition or an aside. For example: The mice – despite their inoculation – displayed symptoms of the disease.

Ellipsis (...)

- Denotes that words are missing from a quotation. For example: 'famine ... leads to disease and high infant mortality.'

Exclamation mark (!)

Displays shock, surprise, horror, etc. Do not use exclamation marks in academic writing.

Full stop (.)

Marks the end of a sentence or an abbreviation where the last letter is not the final letter of the complete word. Do not use full stops in abbreviations other than when the last letter is not the final letter of the word.

For example: Prof. requires a full stop; however, Mr does not; neither does DNA.

Italics

Use for titles of books, plays and films. They are also used for foreign words.
For example: *et al.*

Question mark (?)

Use to end sentences that are direct questions. For example: Why is academic writing so important?

Quotation marks ('...' "...")

Use single inverted commas for quotations from texts you are using. Use double quotation marks for quotations within quotations and for reporting direct speech.

For example: Jones concluded that 'anti-bacterial hand wash was crucial in the fight against swine flu' (2009, p. 34).

One patient remarked that she had "never suffered from eczema" until she moved to the area.

Semi colon (;)

Use to separate two independent clauses in a sentence.

For example: The results were inconclusive; no definite solution to the problem was forthcoming.

Semi colons are also used to separate items in lists when the descriptions are several words in length.

For example: The influenza virus was found to have affected the following participants: patients with asthma; patients who were over the age of 75; patients who had pulmonary heart conditions; and patients who were clinically obese.

8.7 Spelling

Word processors have spellcheckers which make life easier for academic writers; however, you need to keep a vigilant eye on your spelling, particularly for those specialist terms which are particular to your discipline and topic.

Spellcheckers usually alert you to a misspelling by underlining a word that the software package does not recognize. Nevertheless, you should remain conscientious about the accuracy of your spelling. Spellcheckers will recognize any words that are in their dictionaries, so that, for example, if you type 'electric currant' the spellchecker may accept this although what you meant was 'electric current'. Also, there will be some specific technical words which the software does not recognize. You will need to be vigilant when using these words in your thesis. You may add technical words to the spellchecker's dictionary. However, you should be sure to add the correct spelling.

Learn the correct spelling of the key terms in your discipline. For example, if you are writing a thesis on a science subject, it is important to know that the plural of 'formula' is 'formulae'. Create a glossary of these specialist words to assist you in the writing of your thesis.

8.7.1 Common misspellings

Although word processing programmes provide useful spellchecking applications, it is your responsibility to double-check your text for possible errors. This check is especially necessary for technical and specialist terminology which may not be picked up by the word processor's spellchecking programme. Some common misspellings are provided in the table below. Check through them and make a note of any that you are unsure about.

Table 8.21 List of common misspellings

Incorrect Spelling	Correct Spelling
Arguement	Argument
Beleve	Believe
Campagn	Campaign
Comitee	Committee
Committment	Commitment

Incorrect Spelling	Correct Spelling
Goverment	Government
Imediate	Immediate
Jepary	Jeopardy
Maintainance	Maintenance
Neccesssary	Necessary
Parlament	Parliament
Priviledge	Privilege
Recieve	Receive
Seperate	Separate

(Source used: McMillan, & Weyers, 2007)

8.8 Proof-reading: useful checklists

You can 'sweep' your text for writing accuracy and style by using the checklists provided below. Performing this task before you hand in a chapter of your thesis to your supervisor should help you in your quest to produce effective, successful academic writing. Read some of the advice offered in the texts listed in the Bibliography to this manual in order to devise useful proof reading lists to check your work against. The tables provided below have been adapted from information supplied in K. McMillan, & J. Weyers (2007), *How to Write Essays and Assignments.* Essex: Pearson, pp. 169-171.

8.8.1 Content

Check that the points you have made are supported by evidence, either from your own original research or from secondary sources. Make sure that the facts you present are accurate and that all sources have been referenced correctly according to the appropriate citation style.

Table 8.22 Checklist – content of text

- ☐ The text is written in an objective manner
- ☐ The text is structured appropriately
- ☐ The examples are relevant
- ☐ All sources have been referenced correctly
- ☐ The facts presented are accurate and correct

8.8.2 Style

Ensure that your writing is clear, uncluttered and precise. Do not include informal language (slang) or jargon. Read your work aloud before you submit it to your supervisor to check that it makes sense and that it 'flows' from one section to the next.

Table 8.23 Checklist – style of text

- ☐ The aims and objectives of the text are clear
- ☐ Your meaning is clear throughout the piece
- ☐ The text is signposted and fluent
- ☐ Any informal language has been removed
- ☐ The style of writing is academic
- ☐ The tense is consistent
- ☐ The length of sections is balanced

8.8.3 Grammar

Use a good grammar reference book, such as Strunk, W. & E. B. White (1979) *The Elements of Style,* 3rd edn. New York: MacMillan, to check your writing. Taking extra care to ensure correct grammar before you submit writing to your supervisor will allow him/her to concentrate on the content of your valuable research rather than on any technical inaccuracies in your writing.

Table 8.24 Checklist – grammatical accuracy of text

- ☐ All sentences are accurate
- ☐ Paragraphing is consistent and effective
- ☐ All grammar checker suggestions have been dealt with
- ☐ The text has been read aloud and is free from errors

8.8.4 Spelling and Punctuation

Poor spelling and typographical errors detract from the quality of your written work. Always double-check your writing for mistakes by attending to your word processor's spelling suggestions as well as performing an extra check of specialist technical words and phrases in your text.

Table 8.25 Checklist – spelling and punctuation in text

- ☐ All typos have been corrected
- ☐ The text has been spellchecked
- ☐ A separate check has been made for specialist terms and subject-specific words
- ☐ Punctuation has been double-checked by reading the text aloud
- ☐ Capitals have been used accurately

8.8.5 Presentation

Make sure that the presentation of your work is clear and accurate. You will create a good impression with your reader/examiner if you take adopt a meticulous and scrupulous approach to the presentation of your writing.

Table 8.26 Checklist – presentation of text

- ☐ The text fits the word count for this section/chapter
- ☐ The text is presented neatly
- ☐ Page numbers are supplied
- ☐ Figures, tables and charts are presented in appropriate format
- ☐ A comprehensive Bibliography has been provided
- ☐ All citation practice is accurate and checked against University criteria
- ☐ The text is spaced appropriately according to University guidelines

9 Citation Practice

Citation practice is a test of your scholarship. Key questions you need to ask yourself include:

- Do you acknowledge the sources for your evidence and arguments?
- Have you charted your intellectual influences methodically and accurately in an appropriate format?

There are numerous different citation styles which have been devised and developed for particular subject areas. Consequently, it is important that you should check with your School and thesis supervisor about what style of referencing is required. For scientific-style theses, the normal referencing style is Harvard. Many Schools provide their own guides for students to follow. Find out if your supervisor or School have their own information or requirements about citation practice and be sure to read these carefully and understand them fully if they do. Remember also that the University library have compiled a number of useful guides to citation practice which are available at: http://libguides.library.nuigalway.ie/Plagiarism/Referencing

In general, always remember that the sources you use in your thesis should be referenced appropriately. Correct citation practice demonstrates that your research is built on firm academic foundations; it also shows that you are not claiming credit for work that is someone else's. Any type of plagiarism is unacceptable. Please refer to the following link on the NUI Galway website for a more detailed explanation of the University's plagiarism policy: http://www.nuigalway.ie/centre-excellence-learning-teaching/teachinglearning/academicintegrity/.

10 Bibliography

This bibliography lists all sources used in this Guide and useful sources for further reading for research students and supervisors. Many of the books are available in the James Hardiman Library or the Graduate Studies Office.

Alley, M (1996) *The Craft of Scientific Writing.* 3rd edn. Virginia: Springer

Beasley, N. and S. Taylor (2005) *A Handbook for Doctoral Supervisors.* London: Routledge.

Beer, D. & D. McMurrey (2005) *A Guide to Writing as an Engineer.* 2nd edn. Austin, Texas: Wiley

Clare, J. & H. Hamilton (2003) *Writing Research: Transforming Data into Text.* London: Churchill Livingstone

Coghill, A.M. & L. R. Garson (2006) *The ACS Style Guide.* 3rd edn. Available at: http://pubs.acs.org/isbn/9780841239999 (Accessed on 28 October 2016)

Council of Science Editors (2014) *Scientific Style and Format: The CSE Manual for Authors, Editors and Publishers.* 8th edn. Chicago: The University of Chicago Press

Creme, P. & M. R. Lea (2003) *Writing at University: A Guide for Students.* 2nd edn. Maidenhead & Philadelphia: Open University Press

Cryer, P. (2006) *The Research Student's Guide to Success.* 3rd edn. Maidenhead: McGraw Hill

Delamont, S., P. Atkinson & O. Parry (2000) *The Doctoral Experience: Success and Failure in Graduate School.* London: Falmer Press

Delamont, S., P. Atkinson, P. & O. Parry, (2004) *Supervising the Doctorate: A Guide to Success.* Maidenhead: Open University Press

Davis, M. (1997) *Scientific Papers and Presentations.* California & London: Academic Press

Day, R. A. & B. Gastel, (2006) *How to Write and Publish a Scientific Paper.* 6th edn. Cambridge: Cambridge University Press

Dodd, J. S. (ed.) (1986) *'Notes on Scientific Writing Style',* Excerpted from: The ACS Style Guide; The American Chemical Society: Washington, D.C. Available at: http://science.widener.edu/svb/essay/writing.pdf. (Accessed on 29 November 2016)

Dunleavy, P. (2003) *Authoring a PhD: How to Plan, Draft, Write and Finish a Doctoral Thesis or Dissertation.* Basingstoke & New York: Palgrave

Eley A., and R. Jennings (2005) *Effective Postgraduate Supervision.* Maidenhead: Open University Press

Gardiner, M. & H. Kearns (2011) *Turbocharge your writing today.* Available at: http://www.nature.com/naturejobs/2011/110707/full/nj7354-129a.html?WT.ec_id=NATUREjobs-20110707#/bx1. (Accessed on 28 October 2016)

Kamler, B. and P. Thomson (2006) *Helping Doctoral Students Write: Pedagogies for Supervision.* London: Routledge

Lee, A. (2008) *Supervision Teams: Making them Work.* London: SRHE

Lindsay, D. (1995) *A Guide to Scientific Writing.* 2nd edn. Melbourne: Longman

McMillan, K. & J. Weyers (2007) *How to Write Essays and Assignments.* Essex: Pearson.

Marshall, S. (1999) 'Supervising Projects and Dissertations' in H. Fry, S. Ketteridge & S. Marshall (eds.) *A Handbook for Teaching and Learning in Higher Education.* Abingdon: Routledge Falmer

Nagan, M.C. & J. M. McCormick (2009) *The Laboratory Report.* Available at: http://chemlab.truman.edu/chemlab_backup/labreports_files/LabReports.htm (Accessed on 28 October 2016)

NUI Galway, *Academic Integrity at NUI Galway.* Available at: http://www.nuigalway.ie/centre-excellence-learning-teaching/teachinglearning/academicintegrity. (Accessed on 28 October 2016)

NUI Galway, *Library Guide on Plagiarism and Citation: Referencing / Citation.* Available at: http://libguides.library.nuigalway.ie/Plagiarism/Referencing (Accessed on 28 October 2016)

NUI Galway, *Library Guide on EndNote.* Available at: http://libguides.library.nuigalway.ie/EndNote (Accessed on 28 October 2016)

NUI Galway (2016) *University Guidelines for Research Degree Programmes.* Available at: http://www.nuigalway.ie/media/graduatestudies/files/university_guidelines_for_research_degree_programmes.pdf (Accessed on 28 October 2016)

O'Connor, M. (1991) *Writing Successfully in Science.* London: Chapman & Hall

O'Shea, F. (2004) *Up With Which I Will Not Put: Writing Skills for Students.* Cork: UCC

Pearce, L. (2005) *How to Examine a Thesis.* Maidenhead & New York: Open University Press

Petre, M. & G. Rugg (2010) The Unwritten Rules of PhD Research. 2nd edn. Maidenhead & New York: Open University Press

Phillips, E. and D. S. Pugh (2000) *How to Get a PhD: A Handbook for Students and Their Supervisors.* 3rd edn. Maidenhead: Open University Press

Powell, K. (2012) *Foreign Tongues.* Available at: http://www.nature.com/naturejobs/science/articles/10.1038/nj7405-129a (Accessed on 28 October 2016)

Roberts, C. M. (2004) *The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing and Defending Your Dissertation.* California: Crown

Royal Society of Chemistry How to Reference Using the Royal Society of Chemistry Style http://www.rsc.org/learn-chemistry/resource/res00001664/how-to-reference-using-the-rsc-style?cmpid=CMP00004956 (Accessed on 28 October 2016)

Rugg, G. and M. Petre (2004) *The Unwritten Rules of PhD Research.* Maidenhead: Open University Press

Silyn-Roberts, H. (2000) *Writing for Science and Engineering: Papers, Presentations and Reports.* Oxford: Butterworth Heinemann

Strunk, W. & E. B. White (1979) *The Elements of Style.* 3rd edn. New York: MacMillan

Taylor, S. and N. Beasley (2005) *A Handbook for Doctoral Supervisors.* Abingdon: Routledge

Temple, M. (1997) *Grammar Book.* Oxford: Blackwell

Turabian, K. L. (1996) *A Manual for Writers of Term Papers, Theses, and Dissertations.* 6th edn. Chicago & London: University of Chicago

Watson, G. (1987) *Writing a Thesis: A Guide to Long Essays and Dissertations.* London & New York: Longman

Winstanley, C. (2009) *Writing a Dissertation for Dummies.* Chichester: Wiley

Wisker, G. (2005) *The Good Supervisor: Supervising Postgraduate and Undergraduate Research for Doctoral Theses and Dissertations.* Hampshire: Palgrave Macmillan

Wisker, G. (2008) *The Postgraduate Research Handbook.* 2nd edn. Hampshire & New York: Palgrave

Zobel, J. (2014) *Writing for Computer Science.* 3rd edn. London & Melbourne: Springer

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