

12 PREPARATION OF A THESIS

12.1 Overview

The research thesis is arguably the most important document that a research student will produce during his/her candidature. In many institutions, the thesis will be the sole mechanism by which the postgraduate research program is assessed. In other institutions, where assessments include both a thesis and a defense, the thesis will constitute a critical, major component of final assessment.

The key point for the supervisor to keep in mind, in relation to the preparation of a thesis, is that it is a structured document prepared by a human for the purposes of being read by other humans. In other words, regardless of whether the thesis is in the humanities or sciences, there are large elements of subjectivity in the process – on both sides. What is seen as an exemplary work by one person may be viewed as a flawed work by another. A major task for the supervisor is therefore to ensure that, at the very least, the subjectivity in the overall process is not on the part of the student. This is a matter of rigor and discipline that needs to be instilled in the research student from the outset of the program.

There are also matters of general (not necessarily universal) convention in relation to theses, and the manner in which they are written by students. Specifically, the writing style needs to suggest that the research student:

- Is a humble learner presenting his/her work to learned,

scholarly peers

- Has learned from other scholars (literature review) and has developed his/her hypotheses in a systematic way, based upon an understanding of the existing state of scholarly knowledge
- Has undertaken the research with an open mind, and in full knowledge of the fact that his/her hypothesis may ultimately prove to be unfounded or not substantiated
- Has been able to develop a methodology which an independent observer would deem to be a fair, balanced and systematic means of determining the value of his/her hypothesis
- Has been able to develop instruments, or a program of experimentation, which can be used to assess the presented hypothesis
- Has been able to assemble/assimilate all relevant pieces of information and evaluate them in an impartial manner
- Is an impartial observer and an unbiased writer who is prepared to acknowledge strengths in the works of others and identify and highlight shortcomings in his/her own work
- Is prepared to provide comparisons/juxtapositions by presenting the work of others in the best possible interpretation, and his/her own work in the least favorable interpretation – in other words eliminate, as much as possible, any personal bias or subjectivity in comparisons
- Understands the relative value/contribution of his/her own work in relation to the field of endeavor, the broader field of study, and the historical context in which the postgraduate research was conducted
- Is able to recommend further research which may go towards addressing shortcomings in his/her own work and further extend the field of knowledge.

All of these elements of writing style need to be learned or absorbed – they are not necessarily a natural talent, and rarely are these elements learned in undergraduate programs to a level suitable for a high level postgraduate thesis.

12.2 Understanding the Thesis Readers/Examiners

Research supervisors, by virtue of their own postgraduate experience, should already be aware that a thesis is a unique document. Unlike a book, it is not aimed at a general audience. Unlike a research paper, it is not even aimed at a general readership of scholars in the field. A thesis is targeted towards a small subset of field-specific scholars who will ultimately act as examiners for the postgraduate research program. That subset of scholars may have particularly strong views about approaches that need to be taken and the manner in which analyses need to be performed. While it may be noble to attempt to change such minds, the reality is that this is unlikely – especially if those holding particular views are renowned experts in the field.

In order to write a thesis, therefore, a research student needs to understand who his/her examiners will be – not necessarily by name but by inclination. If the research student has done his/her job correctly, and has conducted a rigorous literature review, then the following issues should have been resolved:

- How many schools of thought are there in the chosen research area?
- What are the strengths and weaknesses of each school of thought?
- Which schools of thought have the greatest scholarly following (citations, etc.)?
- Who are the prolific/seminal authors for each school of thought?
- Is there common ground between any of the schools of thought?
- Why do the different schools of thought exist, and what are the unresolved issues between them?
- What are the specific reasons for the research student having selected one school of thought over others?
- Does the research student's selection of a particular school of thought risk biasing research outcomes or leaving important issues from another school of thought unaddressed?

The answers to these questions should inform the research student as to who the examiners will be, and what sorts of things will interest them. Importantly, the research student needs to:

- Respect all schools of thought in the field
- Acknowledge that all schools of thought have strengths and

weaknesses – and ensure that the selection of a particular pathway for the research program has not been to the denigration of other approaches

- Acknowledge that the pursuit of one school of thought over others is naturally limiting the scope of the research work
- Juxtapose the least favorable interpretation of his/her research against the best possible interpretation of work in other schools of thought to demonstrate impartiality.

In addressing a particular audience, the student's objective is not necessarily to change the views of those wedded to a particular school of thought but, rather, to get them to respect the student's selection, and understand that a choice has been made in a systematic manner, and in cognizance of its strengths and limitations.

It is also important, in creating a thesis, that the research student does not seek to create a document that attempts to be all things to all people. It isn't possible to please every reader with the research choices that are made during the course of the research program, but it is important to understand which people may not be pleased with them and why.

Ultimately, however, no matter how well a research student crafts his/her thesis, it is possible that the choices which he/she has made will offend some readers who are wedded to other views. If the research supervisor and the research student have been thorough in their investigations, they should be aware of specific academics with strongly held views who, if selected to examine a dissertation, could provide an unfair assessment. Universities may, depending upon their internal processes, provide mechanisms by which research students and/or their supervisors can formally request that particular academics are specifically excluded from the examination process in order to ensure fairness.

In summary, therefore, it is particularly important that the research student and supervisor take particular care in the conduct of the literature review in order to understand the target audience of the final research thesis. The literature review will create a picture of the target audience for whom the thesis will be created.

12.3 Thesis Structure – Developing a Thesis Template

It should be apparent from the discussions in Section 12.1 that, regardless of the discipline or specific field of research, all theses need to have some basic, underlying elements covered. There are any number of permutations in which these elements can be documented and, for each research student and project, a supervisor needs to have in mind the sort of sequence in which ideas need to be presented.

For each field of research, and its sub-disciplines, there may also be conventions that will guide the research student and supervisor towards the final thesis structure. In addition, each university will have broad enveloping guidelines and formats to which theses will need to conform.

In the absence of any other, more specific, guidelines, Table 12.1 provides a basic seven-chapter thesis template. This can either be used as a point of reference or a point of departure for the supervisor and student. The structure allows a research student to present his/her ideas in a logical sequence that begins with the basics:

- What was the objective of the research?
- When was the research conducted?
- Where was the research conducted?

and subsequently moves the reader through the details of the program, ultimately providing the outcomes:

- What were the conclusions of the research?
- What were the implications of the conclusions?
- What were the limitations of the research?
- What impact did the limitations of the research have on the credibility of the conclusions?
- What further work can be performed in order to mitigate the shortcomings of the research or extend the work documented thus far?

<i>Chapter or Section Title</i>	<i>Purpose</i>
Abstract	A short piece of text that summarizes the research program and its findings. The abstract is used by others for library cataloguing and literature search purposes
1 Introduction	A chapter designed to overview the purpose and background of the thesis, together with the proposed methodology and testing techniques. The introductory chapter needs to summarize what existed prior to the research; the specific contributions of the research and what existed after the research was completed. The chapter should also provide an explanation of how a defense of the research is presented within the remaining thesis structure
2 Literature Review	This chapter summarizes the mechanisms by which the research student identified key researchers and the major forums for publication of work. The research student needs to demonstrate, in this chapter, how he/she developed a research methodology and experimentation scheme based upon the work of peers.
3 Methodology	The methodology chapter details the proposed ideas and concept that form the basis of the investigation (the hypothesis)
4 Experimental/ Instrument Design	This chapter is critical to the research student because it demonstrates how he/she was able to develop unbiased, systematic experiments or instruments for testing the validity of the proposed hypothesis
5 Results	The results chapter provides a forum for the research student to systematically present and summarize the data arising from the experiments/studies that were performed or instruments used.
6 Broad Context Discussion	It is particularly important for the research student to take the experimental results and provide a discussion of their broader context - how they compare with other researchers and published work; how significant the results are to society, industry or a broader field of study.
7 Conclusions and Recommendations	The final chapter which summarizes, in an unbiased manner, the findings of the research, relative to the stated objectives in the first chapter. The concluding chapter should also highlight the deficiencies of the research and how these could be remedied through further investigation.
Appendices	The appendices are used as an area for storing information which is important to the arguments raised in the thesis but, because of its length, detail or complexity, would otherwise interrupt the flow of arguments in the thesis.
Bibliography / References	A detailed listing of the sources from which knowledge and specific information was acquired.

Table 12.1 – Basic Seven Chapter Thesis Template

12.4 Flow of Argument Complexity

A good research thesis ultimately tells a story about a program of research – starting with how, when and where it was conducted, and what its objectives were. Without these basic ingredients as a starting point for the document, the reader may be left confused as to the purpose and context of a long and generally complex document, which needs to be carefully interpreted in order to understand the value of the research.

A thesis reader is assumed to be a scholar with expertise in the subject field so, perhaps unsurprisingly, a common flaw in postgraduate theses is that research students try too hard to impress the reader with the complexity of their arguments. In so doing, the research story gets lost, readers get annoyed, and what may otherwise be good research gets questioned by examiners. A good technical writer appreciates that it is very difficult to get ideas across, and so a reader needs to be eased into the process.

It is also important to understand the context in which a thesis is to be read before commencing writing. In particular, a thesis examiner may agree to assess the work months before receiving a copy of it from the university. By the time the thesis examiner has received the work, he/she may have completely forgotten the background and context to the research. In authoring a thesis, the research student's task is to put the reader into the picture right at the beginning, so that the examiner can quickly come to terms with the research story that is about to be told.

The research story cannot be told by simply concatenating a series of complex technical ideas and sentences into a lengthy document. The thesis needs to contain a spectrum of information, including:

- Ideas that can be understood by a lay-person
- Ideas that can be understood by a generalist professional in the field
- Technically complex concepts that can only be understood by a field expert
- Conclusions that can be understood by lay-professionals.

It is this change in complexity in the flow of arguments that makes the thesis more readable and the research story all the more compelling.

Figure 12.1 shows the flow of writing complexity from the beginning of the thesis through to the conclusions – specifically, targeting the lay-person, moving forward to the general professional, then the field-specific professional, and then the lay-professional. The same basic principle needs

to be applied within each chapter of the thesis and, ultimately, within each section in each chapter of the thesis.

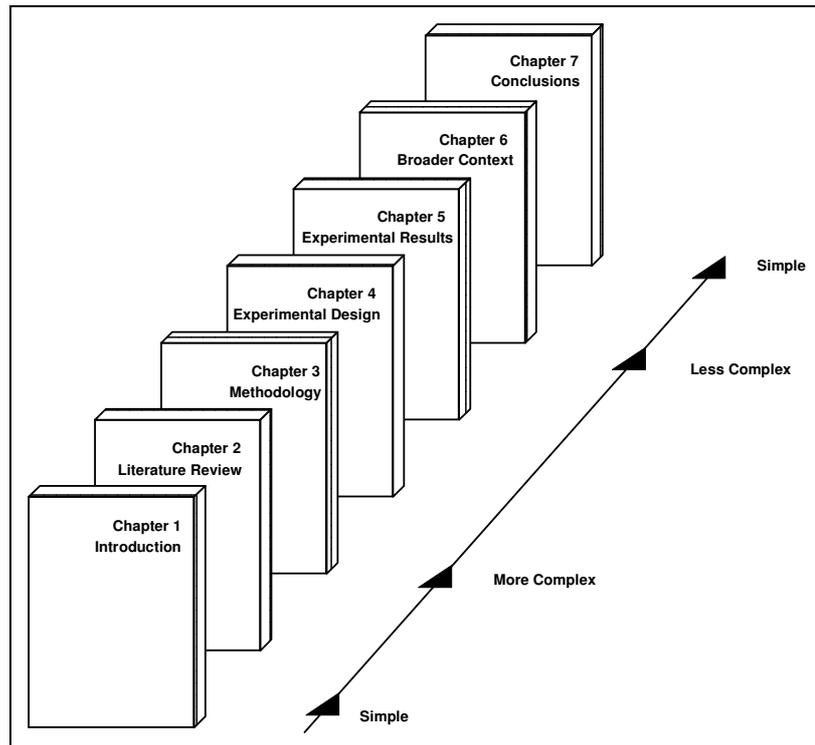


Figure 12.1 – Complexity of Argument Flow in a Thesis

A thesis introduction needs to be crafted in such a way that it sets the scene for the remaining research story. Specifically, it needs to begin with:

- The central research theme – that is, in simple terms, the hypothesis to be tested or the question to be answered
- A statement of where the research was conducted (i.e., the university, faculty, institute, center, department or research group)
- A statement of when the research was conducted (i.e., starting and finish years)

- A statement of why the research was conducted and in what context (e.g., the research was conducted as part of a larger research collaboration).

These things are not just minor details, they are important pieces of information that the reader needs to understand in order to interpret and assess the research work and the thesis. It should also be kept in mind that, as a historical document which will be catalogued in a library and placed online, the context of the thesis is especially important. Consider, for example, that someone reading a thesis on semiconductor physics will interpret the document differently according to when the research was conducted – that is, research conducted in the 1960s would be interpreted differently to research conducted in 2016. So, the where, when and why of the research are important starting points. Consider Example 12.1 in terms of the opening sentences for a research thesis.

Example 12.1

"The purpose of this thesis is to document a Doctoral research program which was undertaken in the Jones Research Group of the Faculty of Business at the University of Northside. The research was undertaken between the years of 2015 and 2018 as part of a broader research collaboration between the Faculty and Setco Investment Partners. The research was supervised by Professor Ray Jones of the Faculty of Business. Broadly, the objective of the research was to investigate the relationship between Liquidity and Market Capitalization in medium sized enterprises."

In Example 12.1, the reader gets a simple overview of the basics of the research program, condensed into a few sentences. From that point, the reader can determine the context of everything that follows. When the thesis moves past the examination phase, and becomes a historical document, any subsequent reader can determine the relevance of the document to his/her requirements.

The complexity of the thesis logically has to increase as the document progresses because the basic purpose of the dissertation is to discuss work in cutting-edge fields. The further that one delves into the document, the more proficient one needs to be in the field in order to understand the arguments or mathematics or experimentation or modeling that are documented therein.

Moving towards the end of the thesis, there is a need for the writing style to again become more generalized – that is, aimed at a broader audience. The ability of a research student to take complex procedures, models and/or experimental results, and to present them in a concise English format, helps demonstrate a mastery of the subject matter. Conversely, when the concluding chapters of a thesis are filled with complex technical information, the reader is left to wonder whether the research student has really been able to bring together his/her findings – or, for that matter, even understands their broader significance.

A good way to check that opening and closing portions of a thesis are hitting their mark is to have a lay-person read them and see if they are able to understand them. Similarly, the overall introductory chapter, literature review and concluding chapter/s should be clearly intelligible to a lay-professional in the broader field of study.

Research students are generally very good at documenting the technically complex (field-specific) portions of the thesis – because that is where they invest the bulk of their research time – but less so at the broader concepts that need to be covered in the introduction and conclusions. These require the student to step back from his/her work and look at the broader perspectives as an outsider. The research supervisor has a role to play in ensuring that the student can do this – not purely from the perspective of the thesis but also because this is a skill required for presenting the research work to a broader audience.

12.5 The Central Research Theme

Albert Einstein is often quoted as having said that,

"If you can't explain it simply, you don't understand it well enough."

Whether or not Einstein actually said it, the quote is particularly appropriate in the context of preparing a thesis, and explaining to the reader the objective of the work.

In Section 2.5.2, the central research theme was raised in the context of research outcomes, and herein this concept is examined a little further because of its profound significance in relation to the development of a thesis.

It has already been noted that a common flaw in postgraduate research theses is that research students simply don't take the time to divorce themselves from the minutiae of the research and understand what it is that they are trying to achieve in a broader context. This shows up, time and again, in research theses where the central research theme is muddled and unclear. Often, the research student sees the central theme of the research introspectively, in terms of highly complex ideas and theories, but is unable to articulate what those ideas and theories mean to the outside world. The supervisor has an important role in assisting the research student to come to terms with the central theme of the research.

By way of background, one needs to understand that it is very difficult to convey a broad range of ideas in a long document, such as a thesis, particularly when the author lacks writing experience, as in the case of a postgraduate student. Thesis writers can lose direction, and meander from one unconnected thought bubble to another, with no sense of cohesion or purpose. Irrelevant material is sometimes included for padding, while critically important information is omitted.

The key to creating a cohesive thesis is to ensure that the student author is able to encapsulate the central theme of the research within a few simple sentences – devoid of technical jargon, acronyms, mathematics or chemistry. Only after the central research theme has been enunciated – simply, clearly and succinctly, can the remainder of the thesis be created.

The central research theme is also the pivotal reference point for all the content in the thesis. Specifically, each

- Sentence
- Diagram
- Literature reference inclusion

- Set of analyses
- Discussion
- Set of results,

needs to be parsed in terms of its relevance to the central research theme. If any content is irrelevant to the theme, then it probably doesn't have a place in the thesis.

The bottom line is that there needs to be clarity of purpose – without this, a student can end up under-emphasizing the important aspects, and over-emphasizing the irrelevant ones.

In Section 2.5.2, two basic examples (2.1 and 2.2) were provided to demonstrate the difference between an ill-considered central theme, replete with technicalities and jargon, and a well-considered theme which takes all the intrinsic complexities of the research and condenses them into a form which can be readily understood by a lay-person. A well-considered theme provides:

- The backbone for the research story that will unfold throughout the thesis
- The central reference point for what the research student should include or exclude from the thesis
- A simple, easy-to-remember frame-of-reference for the thesis reader, by which he/she can parse the validity of each claim, inclusion, exclusion or conclusion in the work – particularly for examination purposes.

The objective is to reassure the reader that the author knows what he/she is doing, because every statement in the thesis ties in to the central theme – there are no spurious inclusions and no obvious omissions. If there is a failure on the part of the student to reassure the reader – or to bamboozle them with over-use of technicalities that make thesis assessment difficult, then clearly there is a potential for a poor outcome.

Examples 2.1 and 2.2 provided evidence of the ability to take a social theme and express it in simple English grammar. However, a common concern is how to tackle a central research theme in areas of engineering, medicine or science, where technicalities are a fact of life. In this context, consider examples 12.2 and 12.3, which look at the problem of developing a central research theme for theses which are in scientific areas.

Example 12.2 – An Ill Considered Scientific Research Theme

The photonic emissions, emanating from intrinsic semiconductors doped with Group V impurities, were modeled using Schrödinger's equations in order to verify that

$$\bar{E} = \frac{\sqrt{\epsilon^2 - \lambda/\pi^3}}{\Phi^{j\omega\alpha} \pm \eta^{N/2}} \dots$$

Example 12.3 - An Enlightened Scientific Research Theme

"The purpose of this research was to investigate the relationship between an applied stimulus energy and the emission of light, in a range of different materials..."

In Example 12.2, the central research theme is mired in a mathematical formula, rather than having been considered in terms of telling a research story in which such formulae will ultimately be revealed anyway. In Example 12.3, the author has considered the central research theme more thoughtfully, and has begun the process of explaining the research story to the reader.

In considering these discussions, as well as those in Section 2.5.2, it needs to be noted that the objective of having a simply stated central research theme is not to underestimate the intellectual capacity of the reader but, rather, to demonstrate the intellectual mastery that the author has over the subject matter. In other words, to be able to extract the simple from the complex.

Once a research student has produced a meaningful central research theme, a supervisor should encourage the student to print it out and keep the printed version visible at all times near his/her workstation – so that each activity, during the course of the research program, as well as the preparation of the thesis, is referenced against it.

12.6 Thesis Preparation Timeline

For many research students, regardless of what advice is given them prior to, and during, the course of the program, the preparation of a thesis will become a mere afterthought, following the research conduct. In these circumstances, the thesis can become a rushed attempt at a complex document – and the results of the retrospective haste will be apparent for all to see and read.

It is a challenging task even for experienced research writers to prepare a lengthy document – potentially hundreds of pages – in a short timeframe. For a novice research writer, such as a postgraduate student, it is a particularly onerous task because it needs an acquired discipline in writing style, as well as a capacity to convey ideas systematically over a complex document.

In Section 2.5 of this book, it was noted that the challenge for the research supervisor is to ensure that the thesis writing process starts early in the research program and, equally, the supervisor's editing needs to also start early. An iterative process needs to be put in place to ensure that, as soon as practical, the research student understands and achieves the required level of disciplined writing proficiency that will need to be deployed throughout the research program, and in the development of any publications relating to the research.

It was also noted in Section 2.5 that research students commonly present thesis portions to their supervisors in *draft* form, where the word *draft* is generally applied as a euphemism for undisciplined and/or unfinished work. It is not practical for a supervisor to assess a research student's capacity to write in a professionally disciplined manner unless the research student is prepared to provide a genuine – and complete – example of his/her work – not a *draft* but a legitimate attempt at a finished product.

In reviewing Section 12.1 and 12.3, it should become apparent that although there are vast differences in the scope of research in varying fields and disciplines, in the context of a research thesis, the basic ingredients are common across the board. Every thesis requires:

- An introduction
- A literature review
- Some explanation of the hypothesis and methodology
- A detailing of the implementation of the methodology
- A presentation of some results

- Some conclusions.

In fact, once a detailed literature review has been completed, and a hypothesis and research methodology formulated, a significant portion of the thesis can be written – prior to the implementation of that methodology. The challenge is in getting research students to understand this, particularly when they are eager to start on the body of the research itself. This eagerness, however, is merely pushing to one side an integral part of the research learning process – disciplined writing.

The writing style that students develop during the course of their undergraduate studies is generally not rigorous enough for a postgraduate research program. A quantum increase in quality is required. The longer the supervisor allows time to elapse before tackling the issue of creating a disciplined writing style, the more difficult the task of correction will become. Better then to tackle the problem from the outset by ensuring that the student comes up to measure before problems compound and become insurmountable.

In Section 2.5, it was noted that a logical approach to ensuring that writing rigor and discipline are tackled early is to set the research student the task of completing the introductory or literature review chapter of the thesis as soon as the initial literature review has been finished. This should set in motion an iterative process, where the student submits and resubmits the relevant chapter to the supervisor until the supervisor is satisfied that the research writing quality is at an acceptable level. The completed introductory chapter then serves as the minimum benchmark writing standard for the research student for the remainder of the research program. Needless to say, this requires a significant investment in time on the part of the supervisor – but, it also needs to be reiterated that part of the supervisory process is having the research student learn how to write professional research documents.

Time overruns on postgraduate research programs are often blamed upon the research student, or even the complexities of the research task at hand. More commonly, however, they arise as a result of the research supervisor's failure to invest time in a disciplined attack on the preparation of the research thesis – from the outset of the program. A good supervisor should help a research student to understand that the thesis is not a minor adjunct to the research process but, rather, an integral part of it. The only way this can be communicated effectively is if the supervisor maintains a disciplined approach to submission of the various thesis elements.

A research supervisor should have, in his/her mind, a general thesis template that is particularly relevant to the field of research being investigated. A good approach is to create a thesis writing time consideration chart that can be broadly applied to postgraduate research programs under his/her charge. Table 12.2 provides an example. A more specific timeline can be developed from this by the student as part of his/her project management chart.

<i>Thesis Element</i>	<i>Time-Based Action</i>	<i>Comments</i>
Central Research Theme	Research student needs to enunciate, in simple terms, his/her research theme as soon as sufficient literature has been reviewed to set directions	Student and supervisor need to agree on a central research theme before the research student starts thesis writing
Introduction	Student to submit complete chapter for review 2 weeks after literature review completion	Supervisor to put in place an iterative review and modification process – until introductory chapter is of a sufficiently high standard to become an exemplar benchmark
Literature Review	Literature review chapter should be completed in full within a month of initial literature reading	Literature review chapter will need to be modified/updated regularly as new literature comes to hand
Methodology	Methodology chapter needs to be completed in full prior to commencement of any implementation work	Supervisor to review methodology chapter prior to approving design of experiments or instruments
Experimental/Instrument Design	Experiments or research instruments need to be designed and documented in thesis prior to commencement of any testing work	Supervisor to review experimental or instrument design chapter prior to commencement of any implementation work
Results	Chapter of tabulated results to be completed as soon as results are in	Supervisor to review results chapter and determine whether additional or different work needs to be performed
Broad Context Discussions	Student needs to present his/her perspectives on broader contexts of research once results have been analyzed	Supervisor needs to review the student's analysis to determine if his/her interpretation of the results is a legitimate extrapolation of the uncovered information
Conclusions	The conclusions chapter should be completed within a few weeks of the broad context analysis	Supervisor needs to review the entire thesis from beginning to end to look at the conclusions in light of the entire investigation.

Table 12.2 – Thesis Preparation Time Considerations Example

12.7 Writing Ability/Grammar

12.7.1 General

Sections 2.5.3 and 2.5.4 of this book examined the issue of disciplined writing and English language proficiency as it pertains to quality research writing as a postgraduate program outcome. Here, the issues are re-examined in the context of the thesis preparation process, as a matter of completeness.

The majority of postgraduate research theses will need to be written in English – either because candidature takes place in an English-speaking country/university, or because the majority of potential examiners in a particular field are English-speaking. This presents significant challenges for research students who have English as a second language – and for their research supervisors – and even more so when supervisors have English as a second language.

Supporting postgraduate research students with English as a second language also creates numerous ethical problems. Chief among these is the question of what constitutes the student's original contribution to a thesis under examination, and what contributions have been made by the supervisor or supporting editors. Each university should have its own guidelines in relation to supporting inputs to the writing process but there are a few points to consider:

- If the thesis is, for example, in the fields of chemistry, engineering, mathematics, medical/biological science or physics, and the examination is based upon the contribution to those fields, does it really matter if poor English grammar has been edited into a higher standard?
- Is it reasonable for examiners of theses in scientific fields to even expect a high standard of English grammar from candidates with English as a second language – especially if the quality of the research has been exemplary?
- Is it reasonable for examiners in scientific fields to ignore the quality of grammar and writing in theses and focus solely on the technicalities of the work?
- Students submitting theses in fields such as English literature are not expected to be experts in chemistry or physics, so is it fair to expect students in chemistry or physics to be experts in English writing and grammar?

As if these considerations were not problematic of themselves, consider also the submission of theses in the fields of arts and humanities, where it may be the case that the subjects relate to the technicalities of language or literature, but the theses themselves are poorly written.

Over and above these problems is the issue of technology. If it is reasonable for a research candidate to use a commonly-available, software-based grammar and spelling correction tool for his/her work, then how is that any different to seeking editorial support from an English language unit at a university?

There are no simple answers to any of these questions beyond the subjective judgment of the supervisor and the examiners, as interpreted through the window of relevant university guidelines. Each supervisor needs to make his/her own subjective decision on the level of editorial input to be provided to a dissertation, such that what is presented to examiners is a reasonable representation of the process of discovery undertaken by the research student.

It also needs to be considered that, in addition to being a tool for the purposes of student assessment, a research thesis is also a library-catalogued historical treatise in which a process of investigation is carefully documented. The thesis, as a historical document, needs to be clear, concise and unambiguous. Therefore, to allow poor grammar and spelling on one thesis, and for that document to be catalogued and placed online as a benchmark, may lead to further deterioration on the next thesis, and so on. In the worst-case scenario, this could eventually lead to documents which are unintelligible from a historical perspective. Once the process of writing discipline breaks down across the research community, it is very difficult to reinstate.

The various English language testing regimes for students with English as a second language should provide reasonable indicators of a student's capacity to write a dissertation. The reality, however, is that even for high-scoring students – and, for that matter, for people with English as a first language – the process of creating a complex, lengthy document, designed to convey elaborate concepts, is an onerous task. The English language is complex and has many subtleties – words which may be technically correct in one context may be completely unsuitable in another context – even though there is no strict, grammatical preclusion to their use.

In Section 12.6 it was noted that it is important for all postgraduate research students to commence the thesis preparation process early in the research program. It is all the more important for those with poor English skills – or those with English as a second language – to start early, because an iterative approach will definitely be required – and this will need to focus

on both writing style and grammar.

It was also noted in Section 12.6 that, from a supervisory perspective, a good approach to thesis development can involve setting the student the task of completing the introductory or literature review chapter of his/her thesis as an early exercise. Keeping in mind the difficulties that a student may have with the English language, a supervisor may need to go through the first chapter multiple times in order to ensure that the thesis meets a benchmark standard that the student can use for future reference. In the case of students with English as a second language, the successful completion of a first chapter helps them to get into the natural English rhythm and banter that is used in documenting research in a particular field.

12.7.2 English Language Support Units

Research supervisors can often complain about having responsibility for a research student's writing skills but such is the nature of modern research in an international university environment. Many universities have established English language support units and editing services to assist students in their endeavors, but supervisors need to be judicious in referring students to these services.

A research thesis is not simply an English language document. In various fields of research, the basic English language is extended with:

- Technical jargon
- Acronyms
- Field-specific turns-of-phrase
- Unusual grammatical expressions.

The language of a particular research field may extend well beyond basic English, and it can be unreasonable to expect generalist editorial support staff in a university unit to be able to cope with the nuances of each particular field – especially in a university that may have hundreds or even thousands of different fields of expertise.

Consider also that a person with poor English skills may submit a badly written thesis chapter to an editorial support unit – which then has to differentiate between the portions of the document that reflect poor English, and those that reflect field-specific language nuances – and all this

without field-specific knowledge.

A research supervisor needs to understand that, in referring a student to an editorial support unit, they may therefore be giving that unit an insurmountable task. Moreover, what is returned from the editorial support unit may have compromised the original technicalities of the thesis – by replacing field-specific jargon with language which is appropriate in a grammatical sense but technically incorrect.

Depending upon the specific field, a better approach – from the supervisor's perspective – is to make use of an available, experienced academic (e.g., a retired one) from the same field of research. The academic can then act as an editorial support person with field-specific knowledge.

In general, however, a research supervisor will need to reconcile himself/herself to the fact that the responsibility for converting a student with poor written communications skills into one with reasonably good research communications skill will be his/hers alone. That is the harsh reality of research supervision in the modern world and, notwithstanding any university regulations about the extent of editorial support permissible in a thesis, something which supervisors will need to consider before taking on students.

Conversely, academics also need to consider the cost to society of overlooking a potentially brilliant student simply because of poor language skills.

12.8 Documenting the Literature Review

12.8.1 General

One of the most poorly written and constructed chapters in a thesis tends to be the literature review. A common error in the creation of a literature review is for a research student to treat it as nothing more than an inconvenient hurdle, which can be leaped over by presenting a collection of seemingly relevant research papers in a concatenated sequence. Ironically, instead of forming the underpinning basis for the research, the literature review chapter in a thesis can unfortunately manifest itself as an irrelevant aside, which merely strings together a collection of seemingly-relevant quotes from authors in the same field.

Consider instead the literature review as the core element of the research program, and one whose objectives are to:

- Provide an understanding of the history, breadth and depth of the field
- Establish/document a timeline of discovery in the field and the milestone events
- Identify key/seminal research papers and scholars in the field
- Identify various schools of thought in the field
- Identify strengths and limitations of each school of thought and elements of disagreement/discrepancy between them
- Determine the existing state of knowledge in a particular field and school of thought
- Identify and formulate a program of investigation to advance the field – based upon the existing state of knowledge and field consensus of current limitations – in other words, provide an impetus for the postgraduate research.

With these points in mind, it becomes evident that the literature review – if well written – is the single most complex chapter in the entire thesis to compile and document. Unsurprisingly, therefore, many postgraduate literature reviews are not well written. A supervisor's task to ensure that they are.

Some of the typical shortcomings of postgraduate literature reviews include the following:

- Reviews are just a long sequence of quotes and ideas from various sources, with no central theme or objective that

underpins their inclusion

- Thesis authors often include references to earlier research findings without an explanation of how these are relevant to the central theme of the research – in other words, the reader is left to make the connections between cited articles and their relevance to the current research program
- Reviews often contain information which is not relevant to the central research theme, and act as mere padding for the dissertation
- Reviews contain the author's (i.e., postgraduate student's) opinions (i.e., personal preferences/biases) on published research, rather than a skilful balancing of strengths and weaknesses as determined by other scholars
- Reviews often come to an abrupt halt without an explanation of how the conduct of the literature review led to – and connects with – the enunciated program of investigation.

One of the most challenging notions for a research student to accept is the fact that the literature review chapter in a thesis needs to be constructed around the central research theme – and, paradoxically, the central research theme is often derived from a review of literature. Therefore, the literature review process needs to take place through a carefully coordinated sequence of events, specifically:

- The conduct of an initial broad review of research literature
- The development/identification of the central theme of the research to be undertaken
- Preparation/writing of the formal literature review thesis chapter, in the context of the central research theme.

Another common problem that has emerged with the advent of technology is that research students can become preoccupied with automated referencing systems, rather than focusing on the more important issues, such as the structure of the chapter and relevance of various literature to their review. While automated referencing systems should be a boost to productivity, they can often become an end in themselves, with students expending inordinate amounts of time automating a process which they may only use once in their lifetimes, particularly if they move to a career outside the research sector. The volume of reference inclusions can also increase frivolously with automated support systems because of their ease of use, but the relevance and inclusion of what is cited can become more and more dubious.

Another concern with these systems, and online (e.g., citation search)

tools is that there tends to be a case of positive reinforcement of previously cited research only, and other important work can therefore be overlooked. This is of particular concern in the case of recently published research which currently has few if any citations but may be particularly important in the context of the student's own postgraduate research.

The research student therefore needs to be circumspect and search the entirety of the literature with as many primary references as possible, and be aware of how the biases of authors, and restrictions on numbers of citations, tends to artificially select for only a fraction of the complete literature.

To use only frequently cited literature, as thrown up in computerized systems offering ranked results, is not only lazy but an incomplete set of information on which to base a review. A seasoned examiner will likely have a better grasp of the entire literature and may expose embarrassing holes in the literature review if not careful. There is also a possibility that the student may omit a pertinent reference authored by the examiner.

As far as inclusion of work is concerned, in general, references should only be included in the literature review chapter of a thesis if they meet one or more of the following criteria, specifically:

- Provision of a historical context to the research
- Provision of a broad-based discipline view of the research field
- Provision of a timeline of discovery and milestones in the field
- Descriptions of the various schools of thought on the chosen research field – and differing/contradictory views
- Analysis of strengths and weaknesses of competing schools of thought in the chosen field
- Current state-of-the-art knowledge in the specific field to be researched
- Published assessments of the limitations of the current state-of-the-art knowledge
- Recommendations from other learned scholars on future research directions.

Moreover, in writing the literature review chapter, the author (i.e., student) needs to give the reader some insight into why particular references have been included. Consider examples 12.4 and 12.5.

Example 12.4:

"The research by Jones (2009) provides a useful historical context to the research undertaken during the course of this Doctoral research..."

Example 12.5:

"There were two discrete, but conflicting, schools of thought on possible solutions to the problem – one was represented by the work of Smith (2001) and the other by Venkatrasan et al. (2004)."

It should not be assumed that the reader knows – or can infer – why particular references have been included – it is the author's job to explain the purpose of an inclusion.

12.8.2 Limitations of the Literature Review

Research students will rarely have the luxury of conducting work in a field in which there exists only a handful of published literature. Even if this is the case in the narrow sub-field wherein the postgraduate research is conducted, the over-arching field will be replete with published work.

Typically, the over-arching field of investigation in which a student works has emerged over decades or even centuries. For this reason, a good literature review needs to place the postgraduate research into context, as part of a timeline of discovery, and so it is important that there is sufficient breadth to provide a meaningful insight into the potential, specific contributions of the postgraduate program.

In any highly published area of investigation, research students are unlikely to be able to provide a complete review of the entire field, and what is reviewed in the final thesis may only be a small subset of the total scholarly work that has been published. A postgraduate literature review therefore has limitations, and the research student needs to address these limitations for the reader. It is important that, in the literature review presented for the thesis, a research student is able to convey:

- The timeline of discovery of the broad field

- The overall size/scale of the field in terms of publications
- The method by which the subset of publications chosen for inclusion in the literature review was selected in terms of its:
 - Relevance
 - Representation of the broader field of published work
- Publication areas or schools of thought which were not examined during the review, and the reasons for their omission.

In other words, the research student needs to demonstrate that the literature which was reviewed was not only relevant but also a balanced and fair representation of the total body of published work in the field.

Finally, the research student needs to be careful in any claims made in relation to his/her postgraduate work and its novelty in the field. Clearly it is not possible to prove a negative argument, and so a research student needs to exercise caution in claims. For example, it is unreasonable to make claims, such as:

"...prior to the commencement of this postgraduate research program, no research had been conducted in this field,"

unless all work in that field has been examined – a task which is generally not feasible.

The fact that a research student has been unable to uncover published work in a particular area does not prove that the work hasn't been published. Moreover, there may be concurrent research under way in the exact same area which has not been published because of some confidentiality arrangement, or work which has been completed and is currently in the process of being published.

When a student tries to overstate the novelty of his/her own work, it naturally invites a reader to try to disprove the assertion. If the work is truly novel then the reader doesn't need telling.

Within a thesis, a research student needs to modestly enunciate the specific contributions of his/her research relative to what has already been published. However, such claims need to be made cautiously, and with a rider that a literature review can rarely be complete.

12.8.3 The Funneling Process

A good way to conceptualize the literature review – and the literature review chapter in a thesis – is as a funneling process, from which emerges the impetus for the research at hand. Consider Figure 12.2, which illustrates the process.

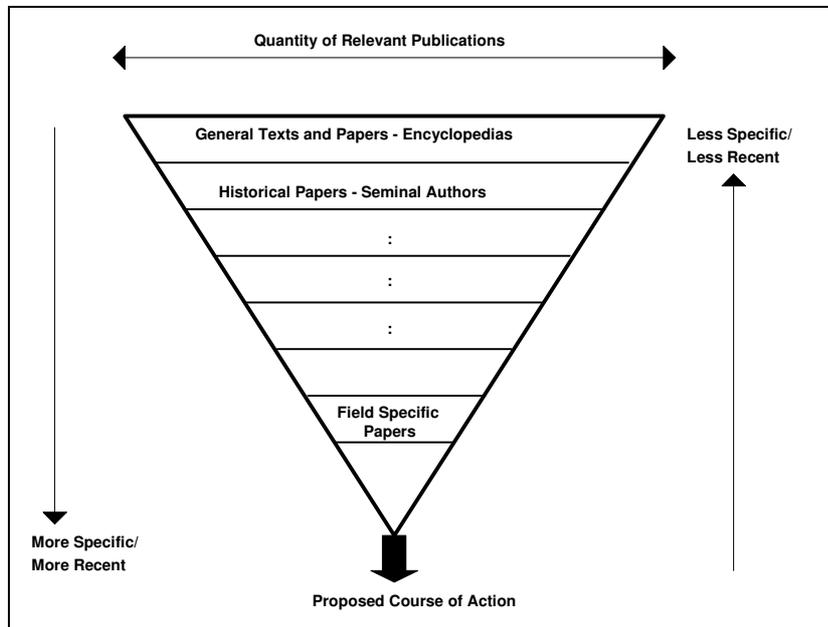


Figure 12.2 – Conceptualizing the Literature Review Funnel

If the horizontal axis of the funnel represents the volume of literature available, and the vertical axis represents the relevance (i.e., subject and time specific material) of the literature, then clearly there will be a large number of publications at the top of the funnel, and relatively few at the bottom.

Considerable skill needs to be applied in assembling the literature review because the author needs to balance the requirements for historical relevance and context, with the need to focus on material that is up-to-date and specifically relevant to the impending research. The literature review chapter in a thesis should ideally be a written manifestation of the "funnel", in order to convey the systematic investigation that has taken place.

12.8.4 Identifying Landmark Research and Seminal Authors

An important element of the literature review process is for a research student to demonstrate that he/she has been able to systematically identify landmark research in the chosen field, and the seminal authors/scholars who were responsible for the work.

Online publications and citations databases make this task relatively straightforward – notwithstanding the limitations noted in Section 12.8.1 – but it is important for research supervisors to ensure that students are not simply extracting numerical data without interpreting its significance.

Superficially, citations should provide some indication of the strength of previously published work. However, a student needs to determine whether work is highly cited because those citing it have valued it as a baseline for research, or because the work was a case-study in erroneous methods or results. Sometimes, research is cited simply because it was cited previously – and it is a convenient way for academics to expedite publication – by citing the cited.

It is also necessary to examine citations in the context of the field in which the publications have arisen. Some fields of research have significantly higher levels of citation than others – for example, various biosciences fields, on average, have higher citations than engineering fields. Generally speaking, pure research fields have higher levels of citation than applied research fields, where the next step in the process is not further research but actual implementation. So, for example, a paper published in an engineering field which receives 20 citations may be more significant in its field than one in biosciences which receives 40 citations.

It is also the case that a paper which has been published for ten years will obviously have more citations than a paper which has only recently been published – because there hasn't been sufficient time for other scholarly groups to use the work in their own research. The research student needs to acquire sufficient bibliometric data in order to make such judgment calls.

Finally, it also needs to be noted that research is not an election-based system. The *correct answer* to a field of study is not determined by the largest number of votes (i.e., citations). Each publication needs to be assessed on its own merits. There may also be a legitimate case for a student to pursue a research field in which publications have few citations – in order to get an insight into why a particular school of thought has not been broadly accepted.

12.8.5 The Literature Review as an Impetus for Research

A postgraduate research program is not intended to be based upon the pursuit of a random thought bubble, in the hope that this will lead to some miraculous breakthrough. Rather, the program is an apprenticeship in rigor – where the research student needs to demonstrate that he/she is capable of identifying research trends and their strengths and limitations – and then, based upon the scholarly work of others, develop his/her own work to extend the scope of knowledge.

A common flaw in literature reviews is that they are reviews of literature for the purpose of reviewing literature – rather than for the purpose of providing an impetus for the research. The end objective is not to demonstrate that a great deal of literature has been reviewed, but to show that the research student has been able to systematically extract a collection of ideas from other learned scholars in the field – in order to create his/her own research directions.

If a research methodology does not logically flow on from the literature review, then an examiner is likely to ask the obvious question of why the review was conducted in the first instance. There must be a logical progression from review to research method. Moreover, the research student needs to explicitly enunciate this connection between review and method in his/her thesis, rather than expect readers to interpret it for themselves.

12.8.6 Writing the Review Chapter

It is likely that a research supervisor will need to provide his/her research student with considerable support in structuring and authoring the literature review chapter – particularly in instances where students have English as a second language. There is no getting around the fact that this is a complex chapter to structure correctly, and a complex chapter to write. A useful template for a literature review chapter is provided in Table 12.3, showing the various sections that might be included within it. Supervisors can use this as a basis for developing a more field-specific version that may better suit their specific requirements.

<i>Chapter Section</i>	<i>Objectives</i>
Introduction	An overview of the end objectives of the review, the areas to be covered, and the order in which they will be covered
Review Methodology	A discussion (defense) on the method employed to ensure that the review was comprehensive, relevant and provided an impartial assessment on possible research directions
Review Limitations	A frank assessment of the strengths and limitations of the review process
Historical Perspective	A discussion on the history of the field and the timeline of discovery to highlight the context and potential significance of any outcomes relative to the total scholarly contributions to the field
Review Topic 1	Discussion of technicalities of the review area – section starts with an overview of why the topic was reviewed, and concludes with a summation of how the reviewed topic contributed towards or influenced research directions
:	
Review Topic N	Discussion of technicalities of the review area – section starts with an overview of why the topic was reviewed, and concludes with a summation of how the reviewed topic contributed towards or influenced research directions
Summation	The summation brings together the findings of each reviewed topic in respect of their relevance to research directions
Research Directions/Impetus	A statement is made as to how the collective findings of the review specifically led to the research hypothesis and/or methodology

Table 12.3 – Sample Template of a Literature Review Chapter

12.9 Balancing a Thesis

12.9.1 The Thesis Body

The primary objective of a research dissertation is to convey the story of a piece of research that was conducted by the research student, in a systematic and compelling manner. This requires judicious editing on the part of the research student (and ultimately the research supervisor) in relation to the content of the body of the thesis – and subsequently, what material needs to be relegated to appendices.

A simple rule that can be employed is that the body of the thesis is used to tell the research story, and the appendices are used to provide the detailed supporting evidence.

In balancing between material for inclusion in the thesis body and that for inclusion in appendices, consider what ultimately needs to be achieved. There are numerous impediments to telling a research story that retains the reader's interest, specifically:

- Long sections of mathematical formulae
- Large slabs of computer source code
- Large quantities of raw or untabulated data
- Numerous graphs, charts and printouts from experiments
- Lengthy observational descriptions of phenomena.

In each case, the author needs to ask himself/herself whether the inclusion of such material is helping the reader to understand the research story, or is it merely padding the body of the thesis to make it look thicker and more comprehensive?

The importance of each of the above materials is dependent upon the field of research – for example, a thesis in mathematics may genuinely call for lengthy sections of mathematical analysis. More generally, however, there are systematic means of dealing with these elements to ensure that they do not become a distraction to the research story that is being told in the thesis. The following guidelines may be of assistance:

- Materials which can be developed by a competent technical or professional person, and which are not unique to the research itself, but are supporting of the methodology, should be relegated to the appendices (e.g., general computer source code)
- Materials which are specific to the research and its findings

should be presented in summary form in the thesis body and the details relegated to the appendices

- Materials which clearly illustrate a particular trend or observation should be presented in the thesis body, and other similar, but not unique, items should be relegated to the appendices.

Table 12.4 provides some suggested techniques for dealing with these materials.

<i>Material</i>	<i>Method of Inclusion in Thesis</i>
Mathematical formulae	Include only key equations in thesis body. Where derivations or proofs have been performed, include only significant steps in the body and refer to complete treatments in the appendices.
Computer source code	Only include <i>unique</i> source code in the thesis. In the body of the thesis only include small, representative or innovative sections of code and refer to more detailed coding in the appendices where required.
Raw/untabulated data	Only include tabulated summary data in the thesis body – and data which shows a trend or demonstrates an anomaly or other phenomenon – more detailed data should be included in the appendices. Raw data should only be included in the thesis if it is small in volume or highlights a specific anomaly or trend.
Experimental graphs, charts other graphical printouts	Only include graphics that demonstrate a specific trend or phenomenon related to the central research theme/hypothesis. Include a representative graphics sample if necessary to demonstrate application of the methodology or unique results – the remainder of the graphics should be in the thesis appendices – and only if specifically relevant.
Lengthy observational descriptions of phenomena	Avoid lengthy verbal descriptions – where possible convert lengthy, written descriptions into tables; timeline diagrams; graphs or charts. If descriptions relate to important interviews or experimental observations relevant to the central theme of the research, include only key points in the thesis body and relegate complete descriptions to the appendices. Do not write lengthy descriptions of phenomena which are self-evident from photographs, tables, graphs or charts.

Table 12.4 – Balancing Between Thesis Body and Appendices

Left to their own devices, and in the presence of readily-available supporting technologies that facilitate the creation of large volumes of data, diagrams, images, etc., research students can be prone to *padding out* the thesis body in the mistaken belief that this will impress readers/examiners. More likely, the practice will alienate the readers because it demonstrates a lack of judicious selection on the part of the student. Research supervisors therefore need to assist and support research students with the selection of materials for inclusion in the thesis body.

A useful approach is to get the student to benchmark every inclusion in the thesis body against the central research theme. If the material in question is specifically relevant to the research theme then it can be shortlisted for inclusion, otherwise it should probably be considered for the appendices.

In the context of supporting a student to make judicious selections about what to include or exclude from the thesis body and appendices, it can also be useful to have the research student question his/her own work in relation to personal reading preferences. Specifically, would the research student, as a thesis reader, want to:

- Read or decipher pages of mathematical proofs in order to understand the research story?
- Read pages of lengthy verbal descriptions, where the same information might be more efficiently conveyed with diagrams, charts, timelines or tables?
- Be distracted from the research story by lengthy passages of supporting material, which is background or supporting material to the central research theme, rather than a key finding?

Ultimately, what should or should not be included in the body of the thesis is a subjective decision, and what the research supervisor and student may agree upon as a sensible approach may not appear that way to a thesis examiner. One has to accept that one cannot expect to get it right and please all of the people all of the time. Nevertheless, by being judicious about the inclusion or exclusion of every element of supporting material in the body of the thesis, the chances of alienating an examiner, by unnecessarily confusing the research story with padding, can be minimized.

12.9.2 Thesis Appendices

Thesis appendices are another potential source of annoyance for thesis readers and examiners. Research students often view them as a place in which padding materials can be added in order to make the thesis look more impressive than it might otherwise be. This is a naive approach and needs to be addressed by the research supervisor.

In the body of the thesis, every decision about the inclusion or exclusion of material should be assessed against the central research theme of the research, and the same rule needs to apply in the appendices. The only difference being that the appendices are a more appropriate location for detailed supporting calculations, mathematical formulae, data, source code, observations, charts, graphs, etc.

It is important not to make the mistake of treating the thesis examiner as a fool – simply by attempting to maximize the amount of information presented in the appendices. A more productive approach is to consider:

- What additional information is required in order for a reader to reproduce the work contained in the body of the thesis?
- What supporting information is required for a reader to assess the links that have been made by a student between raw information and the conclusions drawn in the thesis body?
- What is the best way of presenting the information so that an informed reader – who has read the body of the thesis – can view and assess the supporting information in the most efficient manner?

In addition to these issues, there is the question of how much supporting information needs to be presented in the appendices – and where the line falls between necessary information and worthless padding?

In Section 12.9.1 it was noted that materials which can be developed by a competent technical or professional person, and which are not unique to the research itself, but are supporting of the methodology, should be relegated to the appendices (e.g., general source code) The issue is where to draw the line.

Consider, for example, that in a thesis in the field of chemistry, there would be no obvious need to include in the appendices details on how test tubes were manufactured – unless that manufacturing process was specifically relevant to particular aspects of the research program. In an engineering research program, where a piece of software was created to perform some analysis, there would be no obvious need to include source

code relating to the development of the user interface – unless that user interface was of particular significance to the central theme of the research program.

There are no hard and fast rules that can be applied, save for the basic test of assessing each piece of material for relevance against the central research theme of the thesis. Beyond this, experience is particularly useful in making subjective decisions, and therefore a supervisor has the capacity to provide valuable support to the research student in his/her decision-making as it relates to balancing the thesis.

12.10 Personal Opinions, Lazy Phrasing/Numerical Phrasing

Research supervisors can have a role to play in explaining to research students the difference between a research thesis and a book. These differences are not always apparent.

Specifically, there is a need to explain that books tend to be read by people who are specifically interested in the views, opinions and preferences of the authors. Moreover, people often read books specifically to get these personal opinions or individual insights, and not necessarily just facts. Even in books that relate to technical matters, such as bioscience, chemistry, engineering, physics or psychology, an author has the grace and latitude to skew discussions in a particular way. Book readers understand that they are getting one view of the world from a book – and that view may be neither complete nor impartial.

A thesis, on the other hand, needs to be written by a student in an impartial manner, and relate to an analysis of:

- Facts
- Data
- Opinions of other scholars

A thesis is not about the personal views of the research student.

In a book, readers can show tolerance to an author who states his/her view that white is black, or black is white. These may form a legitimate opinion or the author's interpretation of the world. This is not a luxury which is generally accorded in the context of a thesis, where each and every sentence needs to be parsed in terms of:

- Accuracy
- Contestability
- Supporting evidence.

There is always some scope for the insertion of professional judgment in a thesis – based upon supporting evidence/information/data or other scholarly opinions – but there is little or no room for unsubstantiated personal opinion.

Research students, who are recent graduates, are unlikely to have developed the strict discipline of research writing within such constraints. Many will have written minor theses and experimental reports, but few will have had them subjected to the rigor of a major thesis as it exists in the context of, say, a Doctoral research program.

This is another important reason why supervisors need to get research students writing their first thesis chapter as early as possible, so that the discipline of research writing can be instilled before misconceptions and mistakes become ingrained, and more time-consuming to correct.

Consider Table 12.5 which shows just a few of the words and phrases which are acceptable in common writing and books, but which may be questioned by an examiner in a research thesis.

In the context of Table 12.5, consider the sentence in Example 12.6, and the issues that it creates when parsed:

Example 12.6

"Most of the research in the field proved to be valuable, although it is said that only a minority of the authors were themselves experts at the time they performed their work."

The specific issues that such a sentence creates in the context of a thesis:

- The implication is that the writer has examined 100% of the research in the field and has determined that more than 50% has a particular characteristic
- The author has not defined *valuable* in any strict context
- The author has not defined who said that none of the authors were experts – nor when he/she said it
- The implication is that less than 50% of the authors were experts in the field, and that there is hard numerical evidence to support this claim.

<i>Commonly Used Words/Phrases</i>	<i>Issues With Usage in a Thesis</i>
All	Suggests 100%, and needs to be substantiated with supporting data
None	Suggests 0%, and needs to be substantiated with supporting data
Most	Suggests >50%, and needs to be substantiated with supporting data
Minority	Suggests <50%, and needs to be substantiated with supporting data
Majority	Suggests >50%, and needs to be substantiated with supporting data
Small	Needs to be defined numerically
Large	Needs to be defined numerically
Vast	Needs to be defined numerically
Above	In referring to previous material, a specific section, subsection, table, figure, chart or equation number should be used
Below	In referring to following material, a specific section subsection, table, figure, chart or equation number should be used
It is said that	Lazy-phrasing – author needs to define who said "it" and when
In my opinion	Thesis is not about opinions, it is about evidence and analysis of other scholarly work
Worthless	Needs to be defined explicitly
Valuable	Needs to be defined explicitly
Easy/simple	Value judgment and has emotive connotations – better to replace with a words such as "straightforward"
Difficult	Value judgment with emotive connotations – may require more formal definition

Table 12.5 – Commonly Used Words/Phrases Which Create Issues in Theses

Needless to say, one can become too pedantic with phrasing and, taken to the extreme, make the writing of a thesis an intractable proposition for a research student. Nevertheless, research students need to develop the discipline of mentally parsing each sentence as they write, in order to determine if there are any shortcomings in their phrasing.

Once parsed, the sentence in Example 12.6 could be re-written, as in Example 12.7, to eliminate the anomalies:

Example 12.7:

"Much of the work in the field proved to be directly applicable to this research program, although Jones et al. (2007) observed that few of the authors were themselves experts at the time they performed their research."

Notice how, in the absence of supporting numerical information, words which had a specific numerical connotation (*all* and *none*) have been replaced with non-specific words, such as *much* and *few*. The source of the observations has been formally cited to demonstrate that it is not just the thesis author's opinion.

These sorts of writing issues should be evident to experienced researchers but they are not necessarily apparent to a novice research student. The supervisor's role therefore is to rein in the student's use of common English phrases, and instill discipline into the research writing. This is not something which can occur immediately – after all, even a recent graduate will have had more than 17 years of schooling and university, during which he/she has developed a natural writing style. The objective is not to damage the core writing style but merely to tighten it up for research purposes.

It has been noted earlier in this text that a good exercise is for a research supervisor to have the research student go through the first submitted chapter of the research thesis and parse every sentence within it, based upon the following criterion:

"Is everything within the sentence independently verifiable?"

If the answer to this question is *yes*, then the sentence can potentially remain as is. If the answer to the question is *no*, then the sentence needs to be rewritten – that is, tightened up – adding supporting data or references as necessary – or replacing specific numerical words with non-specific words.

If a research supervisor begins the task of teaching disciplined writing skills from the outset of the research program, he/she will find that students tend to be quick to adopt and learn the techniques. This makes the ongoing task of thesis review more straightforward for the supervisor, and the research story told by the research student more compelling for the reader.

12.11 Creating a Cohesive Document

A thesis needs to be more than a collection of discrete and disconnected chapters if it is to create a compelling research story for the reader. A thesis is not a novel, but some of the elements of novel writing can be deployed in order to make the thesis flow smoothly, and to create a document which is greater than the sum of its constituent chapters.

Figure 12.3 shows the end of each thesis chapter linking to the beginning of the next thesis chapter in order to create a smooth and consistent flow of arguments and ideas from beginning to end.

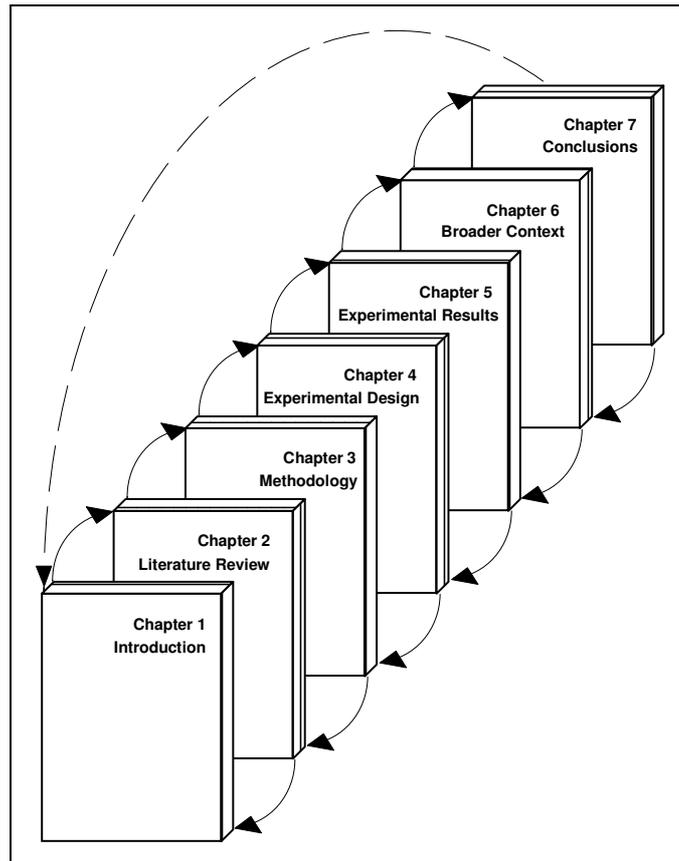


Figure 12.3 – Chapter Linkages in a Thesis

The question is how the linkages, shown in Figure 12.3, should occur. Consider Example 12.8, which shows the final paragraph of the Literature Review chapter, and Example 12.9, which shows the first paragraph of the ensuing Methodology chapter .

Example 12.8

"...In summary, the reviewed literature demonstrated a significant gap in testing of hypertensive medications in young adults, aged in the 20-25 group. Five of the uncovered research studies recommended that further testing be carried out. This formed the basis of this Doctoral research program, the methodology of which is discussed in Chapter 3 of this thesis."

Example 12.9

"The Literature Review chapter of this thesis documented a number of deficiencies in the testing of hypertensive medications in young adults. In particular, various research studies were cited therein which identified the need for an investigation into the effects of hypertensive drugs on young adults in the 20-25 year age group. This formed the basis of the research directions outlined herein. In this chapter, the methodology for undertaking the study is outlined in some detail..."

In these examples, the concluding paragraph of a literature review chapter is paired with the opening chapter of the methodology chapter. One could argue that this leads to some repetition, and that the reader should be able to make such obvious linkages for himself/herself. However, this does not necessarily reflect how a thesis might be read. A thesis examiner may read one thesis chapter every now and then, in between other duties, and so the thesis author needs to insert reminders and repetitions throughout the document to refocus the attention. These should summarize and bring together earlier arguments that may have been forgotten with the passage of time.

Without linkages and reminders, it is common for examiners to flag non-existent errors in the research process or thesis – simply because they have forgotten that various points have already been covered earlier in the dissertation. The worst-case scenario for a thesis that includes linkages and reminders is that examiners will argue that there is repetition in the work – a far less serious misdemeanor.

A reader should therefore not just accidentally bump into a new chapter or section, and be left wondering why he/she is reading it – and, for that matter, how or why it follows on from the previous chapter. The author's task is to ease the reader through the document by explaining how the conclusions of the current chapter lead on to an examination of ideas in the next chapter.

The summations of one thesis chapter should naturally lead into the introduction of the next chapter. The same approach should also apply to chapter sections and subsections – although, in these instances, the linking text may be as short as a single sentence.

Considering the thesis in its entirety, one of the objectives of the first chapter is to explain to the reader the structure and sequencing of the remaining chapters – so that the reader can gain some insight into how a complex story is going to unfold. This insight may also avoid having thesis examiners make unnecessary criticisms of the research process because the broad picture and process of discovery is explained from the outset.

There also needs to be a natural/logical progression/flow from chapter to chapter, and not just a staccato collection of isolated and disconnected ideas and commentary. Overall, if the research has been conducted through a systematic and logical procedure, then the thesis chapters should reflect this flow of ideas and findings.

At the end of the thesis, the concluding chapter needs to address the questions/challenges/hypotheses that were put forward in the introductory chapter and, based upon the content of the intermediary chapters, present an impartial assessment of what has been achieved.

12.12 Understanding The Broader Context of the Research

A research student, particularly in higher-level programs such as a Doctorate, needs to demonstrate to examiners a degree of maturity in terms of his/her approach to the research program. Part of this needs to be manifest in the research student's explanation of how the current research fits into the broader context of the field – both historically and technically.

The research student's ability to explain his/her work in the context of other research should demonstrate that the research student:

- Has a sound grasp of the research literature and the relative significance of his/her findings
- Can objectively assess the specific contributions of his/her research relative to the overall history of the field.

These are not minor achievements in terms of learning the practice of research. They show that the research student can differentiate fact from fiction and personal perception – or even ego – when it comes to assessing the quality of conducted research.

A research student's enunciation of the broader context and implications of his/her work also provides a forum in which the student can ensure that the significance of his/her research is neither overstated nor understated. In other words, that the research student is able to accurately portray the facts relating to the achievements in the postgraduate research program.

It may be of value for the research student to devote an entire thesis chapter to the broader context of his/her field and the specific, relative contributions made during the conduct of the postgraduate research. From the perspective of the research supervisor, there is an important role to be played in supporting the research student to come to terms with the relative significance of the postgraduate outcomes.

12.13 Understanding the Concluding Chapter

The concluding chapter, along with the literature review, can often feature among the most poorly written chapters in a thesis. Perhaps, having devoted a lengthy period of time to the preparation of the main body of a dissertation, research students become too eager to finally bed the work down, and the conclusions suffer unnecessarily.

Common problems with the concluding chapter in a thesis include:

- Unsystematic presentation of findings/results
- Lack of correlation between original hypothesis, results and drawn conclusions
- Presentation of opinions for future research – rather than directions drawn directly from the limitations of the research itself.

The concluding chapter of a thesis need not be an onerous task for the student author. If the preceding chapters of a thesis have been carefully prepared, the concluding chapter should largely write itself. Essentially, the concluding chapter of a thesis should bring together the summations at the end of each of the preceding chapters, in order to present the contributions of the work – in its entirety – to the reader (examiner). This presentation should unfold in the same natural progression as has been intrinsic in the structure of the thesis.

In addition to bringing together the findings and contributions, enunciated in each preceding chapter, the concluding chapter also needs to provide some introspection on the limitations of the research that has already been presented. The limitations of the research need not be based on opinions but rather the logical enunciation of areas which have been identified during the course of the research/thesis as shortcomings.

Finally, having enunciated the findings, contributions, strengths and shortcomings of the research, the concluding chapter should contain the author's recommendations for future research – based upon those shortcomings or limitations that have been presented.

Figure 12.4 illustrates how the basic elements from the preceding chapters need to come together in order to create a systematic concluding chapter that presents a compelling argument, outlining the contributions, strengths and weaknesses of the research.

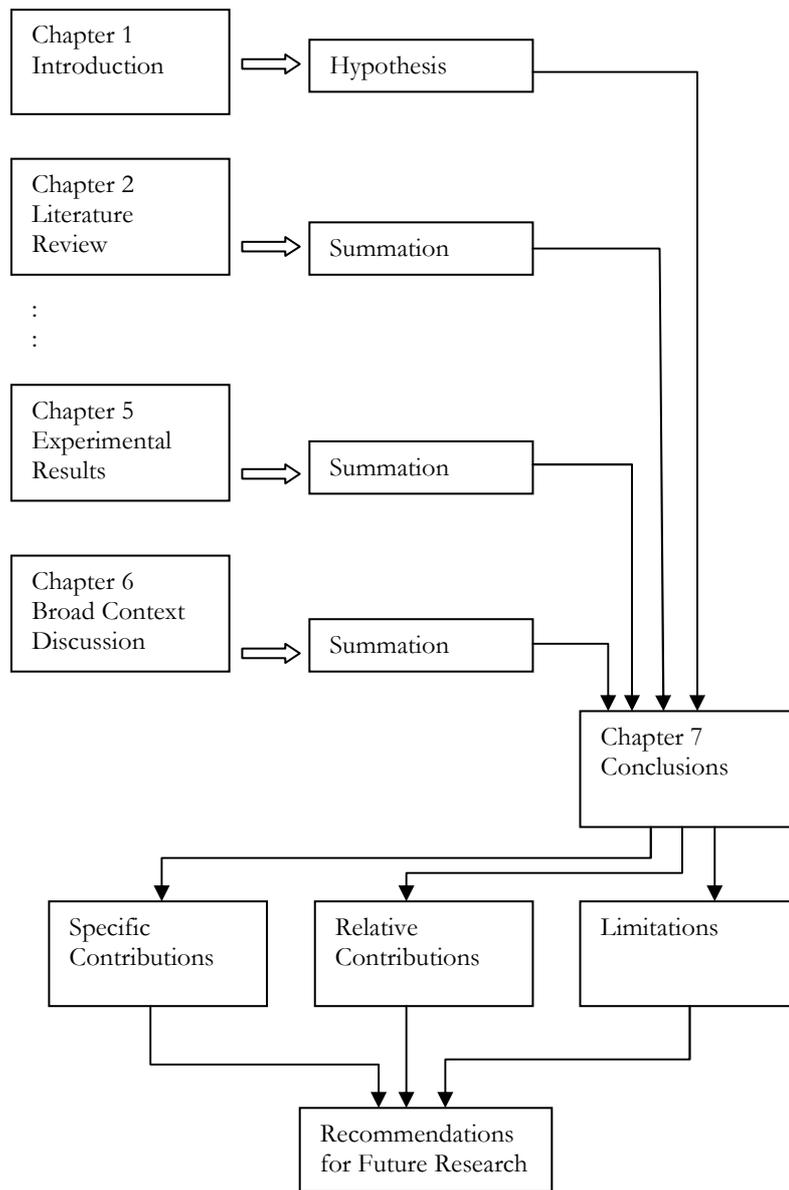


Figure 12.4 – Bringing Individual Thesis Elements Together to Create a Compelling Concluding Chapter for the Thesis

2.14 Understanding the Abstract

The thesis abstract has multiple functions, not the least of which is presenting a succinct summary of the work and findings that will enable:

- Library and online cataloging of the published work
- Future readers/researchers to determine whether the thesis (i.e., research program) is relevant to their interests
- Readers to establish the context in which the research was conducted.

With these points in mind, it is apparent that the abstract should be written, as much as possible, with the lay-person in mind, because it holds as much importance as a tool for telling some people that the research is not relevant to their needs as it does to telling others that it is. Many readers will come across the thesis abstract in an online database and will need to determine whether it is worth pursuing and reading the entire document. A well written abstract can therefore save future researchers time and energy if it is well written.

Many abstracts are replete with technical jargon, mathematical formulae, acronyms, etc. and make the task for the reader more onerous than it may otherwise need to be.

The basic elements that should be considered for inclusion in the thesis abstract are:

- When the research was conducted (i.e., commencement and conclusion years)
- Where the research was conducted (i.e., university, faculty, institute, department or center)
- Why the research was conducted (i.e., the central research theme of the thesis, in lay-terms)
- Who paid for the research to be conducted (i.e., government grant, commercial funding, etc.)
- How the research was conducted (i.e., the methodology summarized into a few succinct sentences)
- The general findings/conclusions
- Any other anomalous/interesting features of the research that may assist a reader in determining whether the thesis is worth pursuing).

Each institution will have its own specific rules/guidelines for thesis presentation and the nature of the abstract itself. Nevertheless,

summarizing a complex piece of research that has taken several years to complete – within a page or two – is often quite a difficult task, particularly for a novice writer, or for a research student who has English as a second language.

Often neglected, but especially important is the context of the research – specifically the *when, where and why* of the program. A research program which is decades old may have useful findings but they may be interpreted in a completely different way to the same type of research conducted in the present day. Also of particular importance to the context of the research is who funded the program. This is an important disclosure that goes to the core of how the research document should be read. For example, if the research documented in the thesis was related to the efficacy of a pharmaceutical product – and the research was funded by a pharmaceutical organization that was deriving a profit from that product, then it might be read differently to research which was funded by an independent government body.

The basic rules for writing the abstract are little different to those that would be applied to writing the thesis itself, and as illustrated previously in Figure 12.1. There needs to be a natural flow of argument complexity – starting with the basics (intelligible to the lay-person), then progressing to more field-specific details and ultimately returning back to basics that are intelligible to the lay-person. Consider Example 12.10:

Example 12.10

"This thesis documents a Doctoral research program undertaken at the University of Wentworth in the Faculty of Arts and Humanities. The work was undertaken at the Center for Asian Studies as part of the Bilstein Research Group, between the years of 2012 and 2016. The work was part of a broader collaboration funded by a United Nations High Commission on Refugees (HCR) research grant. The broad objective of the research was to investigate the relationship between poverty and the spread of infectious disease across three countries.

:

[Technical details of research program, specific findings and contributions]

:

In summary, the research results demonstrated that there was significant correlation between a range of poverty factors and the spread of disease in the countries that were investigated during the course of the research.

Note that by providing a preamble and summation in lay-terms, the abstract provides the broadest range of readers with the greatest opportunity for determining the relevance of the thesis to their specific interests. Those who are specific to the field can read the body of the text to the required depth, and those who are not can determine whether the technical portions need to be read at all.

12.15 Summarizing the Research Supervisor's Role In Thesis Preparation

Considering all the issues raised in this chapter, it becomes apparent that the role of the research supervisor in supporting the student's preparation of the thesis is a complex one.

It is neither fair nor realistic to expect a research student – particularly one with no prior research history – to produce a lengthy document in a rigorous form without support and training. The difficulty is clearly in determining how much support and training should be given in order to ensure that what is ultimately prepared is a genuine reflection of the research student's capabilities. This is a subjective judgment that each supervisor will need to make for himself/herself in cognizance of the specific thesis structure and presentation rules of his/her institution.

The key point to consider is that the rigors of research writing need to be developed from the outset of the program in order to avoid having to untangle an unintelligible mess at the end, when the work is due to be submitted. It has been stated on several occasions in this text that this requires a real and substantial early effort on the part of the supervisor. This should put in place an iterative editing and correction process, in order to ensure that the student develops basic research writing skills to a required standard – and so that the student understands that there is a benchmark by which all future writing will be assessed. Once research students understand that there are benchmarks, below which work will be deemed unacceptable, then they will raise the standard of their writing and, hopefully, iteratively improve during the remainder of the postgraduate program.