Research Skills for Students Commencing a PhD or Masters by Research

Workshop 3

Managing and Reviewing the Literature
(Science/Applied Science Stream)

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Objectives:

- to discuss methods for keeping track of your literature
- to identify the elements of a good literature review
- to examine strategies for writing a good literature review
- to help you clarify your own thoughts about the literature you are reviewing
## Timetable

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>9.00 – 9.30</td>
<td>Keeping track of the literature</td>
</tr>
<tr>
<td>or 2.00 – 2.30</td>
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<tr>
<td>9.30 – 10.15</td>
<td>What makes for a good literature review?</td>
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<td>or 2.30 – 3.15</td>
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<tr>
<td>10.15 – 10.30</td>
<td>Break</td>
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<tr>
<td>or 3.15 – 3.30</td>
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<tr>
<td>10.30 – 11.00</td>
<td>Stages in writing a good literature review</td>
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<tr>
<td>or 3.30 – 4.00</td>
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<tr>
<td>11.00 – 11.30</td>
<td>Thinking about the literature you are reviewing</td>
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<td>or 4.00 – 4.30</td>
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<tr>
<td>11.30 – 11.45</td>
<td>Evaluation and close</td>
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<tr>
<td>or 4.30 – 4.45</td>
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Exercise 1
5 minutes free writing to the prompt:
My approach to collecting and managing the literature I need for my research is
Literature searching and storage

Searching

- Where to start?
  (Get to know your Reference Librarian. What are the key data bases? What types of sources will you use? Will all your sources be academic journals? If not, where to access other materials? How to search effectively?)

- Be systematic in your search and in recording referencing details: consider date, place, author and location

- Find out leading researchers in your area and focus attention there but also think laterally

- Cover the main ideas

- Talk to others, be a good sharer

Storage

- You are building your own library

- Start your thesis bibliography NOW

- Record the vitals but also record your COMMENTS including critical responses to this article

- **Schedule time for this task**
Databases
   Which databases are relevant to your field?

Library catalogues
   Not just UWA

Digital archives
   Great for ephemeral publications; theses

Citation Indexes
   Web of Science

Google Scholar

Collegial Networks
   Supervisors, other students, conferences, mailing lists

Others?

- Think of synonyms and alternative terminology
- Look at the terms used by authors in your field
- Look for controlled vocabulary in databases (subject headings, tags)
- Truncate your search terms to allow for variation in word length or spelling
- Think of broader terms, narrower terms or related terms and phrases depending on your initial search results

**Ask a Librarian**
http://www.library.uwa.edu.au/library_services/ask_a_librarian

Reference librarians can
- answer questions about “using the Library’s collections, resources and services….Responses will usually be issued by the next working day”
- offer training sessions in information literacy (contact your subject library for further details)

Information literate individuals can:
- recognise when and how much information is needed
- know how information is organised
- effectively access and evaluate information
- manage information
- understand economic, legal, social and cultural issues in the use of information
- use information in such a way that others can learn from them
Using electronic resources

Guides have been produced for the following high-use electronic resources.

- AustLII
- BailII
- CCH Library
- ComLaw
- Current Contents Connect
- ERIC
- Factiva
- Informit
- LawbookCo.com.au
- LexisNexis AU
- Ovid
- ProQuest
- SciFinder Scholar
- State Law Publisher
- WebSPIRS
- Westlaw

General guides

- Article Finder
  A guide to locating an article and other materials using Article Finder.
- Catalogue
  How to search the UWA Library catalogue.
- Citation Searching
  A guide to tracking journal articles using citation linking.
- Citing your sources
  A range of guides for the major citation styles used at UWA.
- Current awareness services
  A guide examining the range of services available in the area of current awareness.
- EndNote
  EndNote help and resources, including filters and manuals.
- Evidence based practice
  A guide designed to introduce you to a selection of resources on evidence based practice.
- Find it @ UWA
  A guide to finding full text using the Find it @ UWA service.
- Researchers' gateway
  Links to information of prime importance to researchers, both from within the Library and elsewhere.
- SuperSearch
  A guide to finding resources and articles using SuperSearch.

More information

- Education, training & support relevant to your faculty

Postgraduate Online Scholarly Literacy : coming soon!
Managing the Literature

Any system you devise should reflect key sections and ideas in your research and should be flexible so that it can reflect your changing ideas as the research progresses.

One example:

Research Project Title:
What differences are there in the ecology and genetic diversity of two groups of nitrogen fixing bacteria that are exposed to the same environmental selection pressures?

Four key themes of relevant literature:

1. Evolutionary relationships of these bacteria (red)
2. Existence in the soil (orange)
3. Existence in plants (yellow)
4. Methods for studying them (green)

One idea:
1st level of organisation:
Colour code articles by theme using post-it notes

Organise within themes using letters and numbers that code for meaning.

File articles alphabetically by author with coloured and labelled tags attached.

Endnote library entries also include colour code as a keyword.
For example:

1. Evolutionary relationships
2. Existence in soil
   a. Abundance (orange A)
      i. Genus 1 (orange A1)
      ii. Genus 2 (orange A2)
      iii. Comparison of genera (orange Ac)
   b. persistence (orange P)
      i. Genus 1 (orange P1) etc

3. Existence in plants
   a. Nodulation of plants (yellow N)
      i. Genus 1 (yellow N1) etc
   b. Nitrogen fixing effectiveness (yellow E)
      i. Genus 1 (yellow E1) etc

4. Methods
   a. Genetic diversity (green GD)
   b. Abundance (green A)
      i. MPN (Green A MPN)
      ii. Direct (Green AD)
      iii. Symbiotic effectiveness (green SE)
Exercise:

What strategies can you use to keep track of the ideas you find in the literature, and their sources? Remember that electronic sources of information MUST be backed up in more than one location.
Using the Literature in a Thesis

Criteria that distinguish high quality theses from marginal theses:

(Centre for the Study of Research and Training and Impact, University of Newcastle, Australia)

<table>
<thead>
<tr>
<th>High quality</th>
<th>Marginal</th>
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<tbody>
<tr>
<td>Literature review: Use and application</td>
<td>o Expert use of the literature in design of the study and discussion of the findings</td>
</tr>
<tr>
<td></td>
<td>o Thorough, clear and incisive reporting of the literature, comprehensive and definitive</td>
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A good literature review takes significant time to develop and requires you to pass through a number of stages:

- Survey the literature
- Develop an understanding of the issues
- Subject this understanding to **critical thinking** processes
- Develop a series of reasoned **arguments** that lead to your hypotheses

**Critical thinking** means subjecting ideas and information to sceptical enquiry in order to identify strengths and weaknesses.
**Stage 1: Literature ‘survey’: Finding a research topic**  
(little critical analysis at this stage)

- Survey the area historically and thematically
- Identify the key issues and major work done previously in your area
- Understand the methodology/ies of the discipline
- Evaluate previous research
- Discover research opportunities
- Define one or more potential topics
- Generate ideas, hunches, and hypotheses
- The most recently published review article on the research area is a good place to start
- The Proceedings of a recent Conference will provide a good initial overview
- Identify key authors

**Stage 2: Developing a proposal**  
(critical reading/critical thinking skills are important)

- Defining a research question
- Establishing the justification/rationale for your project
- Demonstrate how your project fits into established research
- Critically review previous research and develop your own criteria for accepting or rejecting arguments
- Demonstrate how your research will make a contribution to knowledge in the field
- Recently completed theses will include a discussion of future directions for this research ([http://adt.caul.edu.au](http://adt.caul.edu.au)).

**Stage 3: Doing the research**

- Refine ideas
- Identify, evaluate and compare methodologies and designs
- Compare results
- Interpret results
- Keep abreast of developments in the field
- Evaluate your ideas against different perspectives
- Detect research that may contradict your hypotheses

**Stage 4: In your thesis**

Synthesise the relevant research literature to demonstrate that you are a competent researcher and that your thesis is valuable. Review the literature critically.
Your Literature Review should address the following issues:

What is the topic and why is it important?
Where did the problem come from?
What is already known about it?
How has this problem been approached in the past?
What remains unknown about this problem? Why?
What controversies are there in the literature about this problem?
What might account for the differences in findings or opinions?
What do you propose to do to resolve this problem further?
Why is your proposed approach likely to be useful?

A good review

- leads the reader to the frontiers of knowledge in the area
- formulates hypotheses
  ("the ideas that distinguish it from a catalogue of facts" Lindsay 1995, p. 70)
- discusses how these hypotheses might be tested
- Shows...that you have integrated the material you read and that you have evaluated the quality of information. After finishing the literature review (readers) should understand the research questions, procedures, and findings that characterise the field. They should also know the weaknesses of past studies and what has to be done to move the field forward. If you have organised the review skilfully you will have led the reader to the conclusion that the absolutely best next study to be done in the area is the one you are proposing. (Cone and Foster 1996, p. 104)

(Learning, Language and Research Skills Library, Student Services – PR 100)
Exercise:
You have been given 3 excerpts from literature reviews that vary in quality. Use the quote below as a means by which to evaluate these excerpts.

“A modern review is judged solely on the quality of its ideas and opinions. The purpose of a review is not to present a catalogue of names, dates and facts, but to present reasoned arguments about the field under review based on as many names, dates and facts as are necessary to support those arguments.” (Lindsay, D. (1995) A Guide to Scientific Writing, Longman p. 69)
How to get started reading an article to review it

Adapted from [http://www.wisc.edu/writing/Handbook/CriReadingBook.html](http://www.wisc.edu/writing/Handbook/CriReadingBook.html)

- Read with a purpose.
- Focus first on summary analysis:
  - Before you read write down some of the facts and arguments you already know about in this field of research (eg free-write for 10 minutes to the prompt “What I know about this topic already is…”)
  - Survey the article or book to make some predictions about what it may cover (what does the title promise? what does the abstract convey? What information can you glean from headings and subheadings?)

As you read individual sections:

- Think carefully about the heading and skim to get an overall sense of the section
- Look at data presented in Tables and Figures, what do you think the data show?
- Test your predictions as you read
- After you’ve finished take notes and begin to evaluate
  - try dividing your page into two columns. In the left, summarize main points made. In the right, record your reactions to and tentative evaluations of that point.
- Once you have read a few articles, write a summary, using your own words, of your understanding of the research area at this point. You could use the free-writing technique or make mind maps. The most important thing is to do something active with the information you have acquired, so that it moves from being information to being knowledge, understanding and ultimately wisdom.

Information: provides answers to questions of “what”, “when”, “where”, “who”, “how much”
Knowledge: an application of information to answer questions of “how”
Understanding: draws on knowledge to answer questions of “why”
Wisdom: an evaluated understanding, for example “What does this mean in the scheme of things?” “How much does this matter?”

Thinking critically about the literature

Deconstructing an argument:

Argumentation really is the vehicle of intellectual enquiry. Scholars will not just state what they think, but give some reasons or evidence to support their contentions. An argument typically consists of the following parts:
  o The premise or claim
  o The logical reasoning and evidence in support of the claim
  o The presentation of opposing views
  o A refutation of opposing views
  o Conclusion

Evaluating arguments:

  o What is the stated research problem?
  o What are the stated research aims? Are they likely to lead to some resolution of the research problem?
  o Is appropriate methodology chosen and is it properly applied?
  o What is your evaluation of the interpretation of the data presented by the author of the paper?
  o Are you convinced by the argument/s presented? On what basis?
  o What do other papers on this research topic say? Is there a difference of opinion? Are there differences in data obtained? Are there differences in interpretation? What might account for these differences?
  o What observations, data, research, logic or theoretical framework are arguments in the literature based on?
  o What assumptions underlie the theoretical framework employed in different papers?
  o Do the assumptions always hold? Under what circumstances might they be flawed?
  o What assumptions underlie the methods used to collect evidence? Are these assumptions reasonable? Under what circumstances might they be flawed?
  o What’s new/ what’s especially valuable about what is contained in this article ie what is its contribution?
A useful framework for reading papers and critically evaluating them.

How to Read an Engineering Research Paper:

Bill Griswold

Reading research papers effectively is challenging. These papers are written in a very condensed style because of page limitations and the intended audience, which is assumed to already know the area well. Moreover, the reasons for writing the paper may be different than the reasons the paper has been assigned, meaning you have to work harder to find the content that you are interested in. Finally, your time is very limited, so you may not have time to read every word of the paper or read it several times to extract all the nuances. For all these reasons, reading a research paper can require a special approach.

To develop an effective reading style for research papers, it can help to know two things: what you should get out of the paper, and where that information is located in the paper. First, I'll describe how a typical research paper is put together.

Despite a paper's condensed form, it is likely repetitive. The introduction will state not only the motivations behind the work, but also outline the solution. Often this may be all the expert requires from the paper. The body of the paper states the authors' solution to the problem in detail, and should also describe a detailed evaluation of the solution in terms of arguments or an experiment. Finally, the paper will conclude with a recap, including a discussion of the primary contributions. A paper will also discuss related work to some degree. Because of the repetition in these papers at different levels of detail and from different perspectives, it may be desirable, to read the paper ``out of order'' or to skip certain sections. More on this below.

The questions you want to have answered by reading a paper are the following:

1. **What are motivations for this work?** For a research paper, there is an expectation that a problem has been solved that no one else has published in the literature. This problem intrinsically has two parts. The first is often unstated, what I call the **people problem**. The people problem is the benefits that are desired in the world at large; for example some issue of quality of life, such as saved time or increased safety. The second part is the **technical problem**, which is why the people problem does not have a trivial solution; that is, why a new technological or engineering solution may be required. Implicitly there is implication that previous solutions to the problem are inadequate. Occasionally an author will fail to state either point, making your job much more difficult.

2. **What is the proposed solution?** This is also called the **hypothesis** or **idea**. There should also be an argument about why the solution solves the problem better than previous solutions. There should also be a discussion about how the solution is achieved (designed and implemented) or is at least achievable.

3. **What is the evaluation of the proposed solution?** An idea alone is usually not adequate for publication of a research paper. What argument and/or experiment is
made to make a case for the value of the ideas? What benefits or problems are identified? Are they convincing?

4. **What are the contributions?** The contributions in a paper may be many and varied. Ideas, software, experimental techniques, and area survey are a few key possibilities.

5. **What are future directions for this research?** Not only what future directions do the authors identify, but what ideas did you come up with while reading the paper?

As you read or skim a paper, you should actively attempt to answer the above questions. Presumably, the introduction should provide motivation. The introduction and conclusion may discuss the solutions and evaluation at a high level. Future work is likely in the concluding part of the paper. The details of the solution and the evaluation should be in the body of the paper. You may find it productive to try to answer each question in turn, writing your answer down. I recommend that you keep a notebook on all the papers you read. You should use my standard one-page form that you can fill out for each paper. In practice, you are not done reading a paper until you can answer all the questions. I will be asking you these questions in class.

Also, you should be aware of the context of the paper in relation to the other papers in the class. Often a paper will represent a generalization, new direction, or contradiction to earlier papers.

If you find that filling out this form doesn't work for you, you can try writing a 250 word abstract of the paper--not rewriting the abstract at the front of the paper, but *your* abstract, capturing the above five issues from your perspective. I often find it useful to write an abstract because it develops the logical connections between the above five issues.

If you are somewhat lost on a particular paper, and sometimes if you are not, it can pay to write down *questions* you have about the paper. Perhaps the paper was vague on key issues, or ignored issues that you think are important. If you come to class with such questions, you are prepared to counter or preempt my own questions.

Reading a book is somewhat different. Although you want to answer the above questions for a book, it may not do the book justice given the amount of detail in each chapter. You may want to fill out the above questions on a chapter-by-chapter basis, and then produce a summary form for the entire book when you have finished reading it. However, each chapter will have a particular slant that may make certain questions irrelevant. Also, a book is often not oriented towards explaining the solution to a research problem. However, engineering books are invariably oriented towards problem solving of one kind or another.

I have a habit of writing on papers directly, less with books simply because they cost so much. A well-annotated paper is worth its weight in gold, as it not only contains the content of the paper, but your assessment of its value to you.
Reading a Research Paper: checklist

Title:
Authors:
Published in:

- What is the motivation for this work? What is the particular problem being addressed? What is the context in which this problem has arisen?

- What is the proposed approach for dealing with the problem or issue? How is this approach an improvement to previous methods of dealing with this problem/issue? How is the approach implemented?
○ **What is the evaluation of the approach taken or solution proposed (both the author’s and yours)?** What questions do you have or don’t you understand? What would you need to know before you would adopt this approach or accept these findings? Is the approach really going to work, who would want it, what will it take to give it to them, and when might it become a reality?

○ **What are the paper’s contributions (author’s and your own opinion)?** Ideas, methods, research results, research techniques etc.

○ **What are future directions for this research (author’s and yours)?** This might be driven by limitations in the present research, or by critiques made by others of this research.
**Structuring your Literature Review**

In writing a review of the literature, you must situate your research question or hypothesis in the context of previous work. This should be done in such a way as to *explain* and *justify* the decisions you are making. What is required to accomplish this is a step-by-step explanation of your decisions, punctuated by references to studies that support your ongoing argument.

**Step one:**
The review of literature is **not** the place to display everything you have read on the subject to date. From your readings, you must select those studies that are critically relevant to your research for inclusion in your literature review.

In the first instance it is helpful to set forth the broad pattern of knowledge as it exists in the area in order to appeal for the reader’s acceptance of the logic you are about to present. So set the scene, then pose your research question and the specific hypothesis through which the question will be answered.

**Step two:**
Organize the literature review into sections that present themes or identify trends, including relevant theory. You are not trying to list **all** the material published, but to synthesize and evaluate it according to the guiding concept of your thesis or research question. Here is where you can really show the reader that you have evaluated the **quality** of the information.

**Step three:**
Identify the line of argumentation you want to pursue. Now you need to marshal evidence for your thesis from the material that you have selected and grouped thematically. Without referring to the specific details in the articles, summarise in one or two paragraphs the combined findings of each cluster of studies. As you present your argument, identify gaps in the research that your study will fill. Also show how your study will extend the knowledge that has already been established.

**Step four:**
Write a conclusion that summarises and reiterates your argument.
In the **INTRODUCTION**, you should:

- Define or identify the general topic, issue, or area of concern, thus providing an appropriate context for reviewing the literature.
- Point out overall trends in what has been published about the topic; or conflicts in theory, methodology, evidence, and conclusions; or gaps in research and scholarship; or a single problem or new perspective of immediate interest.
- Establish the writer’s reason (point of view) for reviewing the literature; explain the criteria to be used in analysing and comparing literature and the organization of the review (sequence); and, when necessary, state why certain literature is or is not included (scope).

In the **BODY**, you should:

- Group research studies and other types of literature (reviews, theoretical articles, case studies, etc.) according to common denominators such as methodological approach, conclusions of authors, specific purpose or objective, chronology, etc.
- Summarize individual studies or articles with as much or as little detail as each merits according to its comparative importance in the literature, remembering that space (length) denotes significance.
- Provide the reader with strong "umbrella" sentences at beginnings of paragraphs, "signposts" throughout, and brief "so what" summary sentences at intermediate points in the review to aid in understanding comparisons and analyses.

In the **CONCLUSION** you should:

- Summarize major contributions of significant studies and articles to the body of knowledge under review, maintaining the focus established in the introduction.
- Evaluate the current state of the body of knowledge reviewed, pointing out major methodological flaws or gaps in research, inconsistencies in theory and findings, and areas or issues pertinent to future study.

Conclude by providing some insight into the relationship between the central topic of the literature review and a larger area of study such as a discipline, a scientific endeavour, or a profession.
Thinking about the literature you will review
Exercise:
Complete the following Table in relation to your understanding of the literature on your research problem.

<table>
<thead>
<tr>
<th>Known</th>
<th>Unknown</th>
<th>Controversial (why?)</th>
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Some useful prompts to focus your thinking when writing Introductions and Literature Reviews

- My research is important/ relevant because….

- My understanding of what we know about my research question (from the literature) is….

- When reading the literature relevant to my research question I wonder about…

- What remains unclear about this question is…

- What I propose to do in this study is…
  This will add to knowledge in the area because…

- My hypotheses are…
  The information that I have based these hypotheses on is…

- The questions I seek to address are…
  The answers to these questions are not already available in the literature because…
Writing space
Research Field
(*the research is about...*)
Mineral composition of the solar system

Research Problem
(*why the research is needed*)
We need to know the composition of the moon before we can understand the origins of our earth, and the composition of the moon remains unknown

Research Question
(*the question/questions the research will answer*)
What is the moon made of?

Thesis statement/hypotheses
(*your educated guess/es about the findings*)
The moon is made of 60% kryptonite, 20% iron and 20% cheese

Research method
What I did to test my hypotheses

Research results
What I found

Discussion/evaluation
What my findings mean in relation to my hypotheses and other research, both past and potential
Additional Resources:

Study Smarter
www.studysmarter@uwa.edu.au
  Free workshops on Referencing and Critical Thinking
  http://www.studentservices.uwa.edu.au/page/64964
  Jump Start: Referencing
  http://www.studentservices.uwa.edu.au/page/113083

Ethical Scholarship, Academic Literacy and Academic Misconduct
http://www.teachingandlearning.uwa.edu.au/page/72852