Thesis Writing Workshops for Graduate Research Students

Workshop 2

Principles of Academic Writing
(Science/Applied Science Stream)

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Objectives:

- To consider paragraph structure
- To consider strategies to improve readability and continuity in academic writing
- To demonstrate the essential components of an Introduction
- To consider strategies for writing a thesis that has a logical structure and communicates effectively
Workshop plan

9.00 – 9.10 Carry over from issues raised last week

9.10 – 10.15 Paragraph structure: theory and exercises

10.15 – 10.30 Break

10.30 – 10.45 Structuring Introductions

10.45 – 11.00 Writing for logical structure and effective communication; text, figures and tables

11.00 – 11.30 Drafting, revising and editing

11.30 – 11.45 Evaluation and close
Paragraph Structure
Good, focussed writing is underpinned by a clear paragraph structure:

1. A topic sentence
   A main idea is expressed, often as a generalisation
2. An explanatory sentence
   The meaning of the generalisation is elaborated on and explained
3. An illustration
   The application of the generalisation is shown by example
4. A conclusion
   This rounds off the points made in the paragraph and lead into the following paragraph

e.g. “Paragraphs in expository writing are characterised by their increasing specificity. That is, they move from the general to the specific, thus, increasingly refining the reader’s understanding of an idea. Well organised paragraphs in academic writing should contain a topic sentence, explanatory sentences, and examples.”

A clear topic sentence is essential to a good paragraph. Topic sentences tell the reader what your paragraph is about, and help prepare them for what you will then say.

Exercise:

1. What is the topic sentence of the following paragraph?
2. Rewrite this paragraph, so that the topic sentence appears early in the paragraph.
3. Restructure the rest of the paragraph so that it communicates its message more effectively.

“We would like to have more information about the high-frequency data, but our model can account for all the information in our simulations. Observations in nature are, however, all too few. But the fact remains that much can be learnt by simulation. Acquisition of real data would necessarily mean that we would have to correct our initial model. In the meantime, the work on improving the simulation will continue.”
(Reference: Scientific Communication 405 Lecture Notes)
An example from a PhD thesis:

Original version: no paragraph structure

The aim of this paper is to illustrate the effects of catchment thresholds on the runoff response and the frequency and magnitude of floods and how the impact manifests itself on flood frequency. The analysis was carried out with the use of a synthetic rainfall model that generates one realisation of a rainfall time-series incorporating rainfall variability at multiple scales: within-event, event, inter-event, annual (seasonal). A particular feature of this rainfall model is its ability to generate infrequent (once in seven years, on average) tropical cyclones that occur over the summer period in the south-west of Western Australia. Derived flood frequency curves were generated through the use of (i) synthetic rainfall time series, and (ii) a deterministic rainfall-runoff model. In this case, for simplicity, we use simple conceptual models that incorporate runoff generation by both saturation excess and subsurface stormflow mechanisms. Flood frequency curves generated for hypothetical catchments near the town of Esperance in Western Australia indicate that flood frequency curves are significantly affected by the catchment thresholds, which is shown as the break in the flood frequency. It is observed that the inclusion of summer storm events increases the occurrence and magnitude of the surface flow component, in this way contributing to steeper flood frequency curves, and possibly another break in the flood frequency curve. The results of this study highlight the importance of threshold on flood frequencies and provide insights into the complex interactions between rainfall variability and threshold nonlinearities in the rainfall-runoff processes which are shown to have a significant impact on the resulting flood frequency curves.
Restructured to include paragraphs that each have a purpose in the argument, and that flow logically from each other.

A modelling approach was used to investigate the relationship between flood frequency, rainfall-runoff processes within catchments, and catchment thresholds, for a hypothetical catchment near the town of Esperance Western Australia. This area has experienced floods that are impacted on by a large number of lakes that introduce significant thresholds to the rainfall-runoff transformation.

Derived flood frequency curves were generated using (i) synthetic rainfall time series and (ii) deterministic conceptual (ie bucket) rainfall-runoff models. The synthetic rainfall time series model used in this study generates one realisation of a rainfall time series that incorporates rainfall variability at multiple scales: within-event, event, inter-event, annual (seasonal). A particular feature of this rainfall model is its ability to generate infrequent (once in seven years, on average) tropical cyclones that occur over the summer period in the south-west of Western Australia. For simplicity, the conceptual models incorporated runoff generation by both saturation excess and subsurface stormflow mechanisms.

The flood frequency curves generated were significantly affected by the catchment thresholds which are shown as the break in the flood frequency. The inclusion of summer storm events increased the occurrence and magnitude of the surface flow component, in this way contributing to steeper flood frequency curves, and possibly another break in the flood frequency curve. This study highlights the importance of threshold on flood frequencies and provides insights into the complex interactions between rainfall variability and threshold nonlinearities in the rainfall-runoff processes that are shown to have a significant impact on the resulting flood frequency curves.
Example:
Consider the following version of an Introduction to a scientific paper.

Version 1:
Various Eulerian link-node models have been developed for the simulation of transport for water quality modelling. For example, Tim et al (2003), Jin et al (1998), Lung and Larson (1995), Gu and Dong (1998) used WASP5 for water quality modelling in rivers and lakes. Barnell et al (2004) and Melching et al (1994) used QUAL2E for river water quality modelling. However, the Eulerian models contain an undesirably large amount of numerical diffusion in the advection simulation (refs) and are found unsatisfactory for transport and water quality modelling. Also, due to the limitations in time steps, Eulerian models may not be suitable for long term simulations of large river systems. In the Lagrangian frame, as the control volumes are moved with the mean flow velocity, numerical diffusion associated with advection is totally eliminated and accurate modelling of transport and water quality may be achieved. Further, a Lagrangian model allows a large time step so that a long term simulation may be achieved.

Can you list the points the author is making?
What is he arguing?
How might you restructure this to make his arguments clearer to the reader?
6 steps to writing good academic paragraphs

1. Select a **topic** for your paragraph and a key **question** that your paragraph will answer (eg the topic may be “features of good academic paragraphs” and a key question might be “what are the features?”)

2. Decide on the **answer** to your question. You may need to do some mind mapping or even free writing to sort out your thoughts first.

3. Use your own words to write a sentence that is a simple and direct answer to the key question e.g. “Good academic paragraphs contain a clear topic sentence, cohesive support, convincing argumentation, and good expression.”

4. Write a cohesive set of supporting sentences. They should be well ordered and contain appropriate transition signals (see A3 handout)

5. Make your answer as **convincing** as possible through effective argumentation. ie use evidence (research data, statistics, expert opinion) and logic. Explain, exemplify and justify your answer.

6. Check your paragraph for good expression, grammar, spelling punctuation, capitalisation and referencing.
Effective reading is a process of anticipating what the author is going to say and expecting it as one reads (Tannen, 1979).

- Readers actively seek a basis for prediction
- Readers make predictions that relate to topic and organisation of text
- Reader predictions are based on words that are read (from the top)
- Topic predictions may be fulfilled by word repetition, predictable word groups
- Items that fulfil reader predictions need to be in a noticeable position; at the front of the text unit
- Readers expect to continue predicting until the final section
- Readers become confused when predictions are not fulfilled
- Unpredicted/unpredictable topics increase reader difficulty

Therefore well written work is structured so that readers are guided in what will follow, and their expectations are actually fulfilled.
Predictive statements make it easier for the reader to follow your writing. These statements may be explicit or implicit.

e.g. “We will discuss the importance of measuring the human face....”
“This paper will present the key features of the Honours programme, then examine the value of an Honours degree, and finally will outline some strategies for students preparing for Honours.” (This will be followed by 3 paragraphs, the first presenting the key features of the Honours programme, the second examining the value of an Honours degree and the third outlining strategies for students preparing for Honours).

or

“There are many reasons for measuring the human face. (Now begin a discussion of the reasons)....”
“There are four main issues to consider when commencing Honours: choosing a supervisor, choosing a topic, becoming an independent researcher and preparing a dissertation.” (Now discuss these issues in order).

You can also make your writing easier to follow by signalling whether you are continuing with a current idea or whether you are addressing new ideas.

Continuity is indicated by repetition of key words (e.g. the structure/structures, the platform/platforms) or by pronouns (e.g. it, they) and adjectives (e.g. this, these).
NB Make sure it is clear exactly what the pronoun or adjective refers to. If in doubt, use the noun instead.

Early sentences in a new paragraph often include old material to provide continuity of thought. As new ideas are introduced, their links to previous ideas are indicated by discourse markers or transitional words (see handout and later exercise).

Change can be signalled by sentences that specify the change; by headings; or by sequence statements (e.g. first, next, another; first, second, third; because, then; the problem, a solution)
Exercise:
Use transition words to rewrite the following so that the ideas are conveyed more clearly

1. Incorporation offers several advantages to businesses and their owners. Ownership is easy to transfer, and the business is able to maintain a continuous existence even when the original owners are no longer involved. The stockholders of a corporation are not held responsible for the business’s bad debts. If the XYZ Corporation defaults on a $1 million loan, its investors will not be held responsible for paying that liability. Incorporation enables a business to obtain professional managers with centralised authority and responsibility; the business can be run more efficiently. Incorporation gives a business certain legal rights. It can enter into contracts, own property, and borrow money.
Exercise:

Transition words can also be used to make it easier for the reader to follow an argument. In the following extract, each paragraph has a specific role in developing the author’s argument. This is signalled within the first few words of each paragraph.

What particular words are used to indicate the purpose of each paragraph? How is the argument structured?
The scientific method has amply demonstrated its validity and power in the areas of inquiry, and for the purposes, for which it has been designed. Witness the spectacular advance of science over the past three hundred years, the large measure of agreement among reputable scientists, and the technological achievements of applied science, every one of which is a pragmatic demonstration of the scientist’s understanding of natural processes.

Science also invites, and supports, more embracing philosophical accounts of nature of the physical world, and no responsible interpretation of reality as a whole can ignore, or contradict, careful philosophical generalizations based upon well-established scientific conclusions. The position I would defend is therefore committed to affirmative reliance on scientific evidence and to the full incorporation, at any point in history, of accepted scientifically supported interpretations of nature.

Science, however, in the stricter sense of the term, is not all-inclusive; it addresses itself to a specific type of inquiry into a specific area of reality for a specific purpose. Pure science concerns itself solely with temporal events, both “physical” and “psycho-physical.” It studies these to discover and formulate recurrences and uniformities, commonly called “laws of nature”; and it does so partly to satisfy man’s native curiosity, partly to facilitate his control of nature for greater human welfare. But, as Professor Stace admits, it is by its very nature unqualified to deal with values; “it can teach us the best means for achieving our ends, it can never tell us what ends to pursue.” This fact is enormously important, for it means that science, in its strict sense, simply has nothing to say about God or goodness or beauty.

Hence the “imaginative picture of the world” which science, in and of itself, supports is of course a picture of a valueless, meaningless universe. How could it be otherwise? But this doesn’t prove that there are no values and no God in the universe; it merely proves that science can’t possibly discover these values and this Deity if they do exist.

Furthermore, no scientific conclusions, at any point in history, are final, definitive, or certain. They are necessarily hypothetical and tentative. It follows that philosophical extrapolations of science are equally tentative and hypothetical. For example, late-nineteenth-century science supported the philosophical doctrine of strict mechanistic determinism; some qualified philosophers today are not sure that the most recent scientific thinking justifies any such philosophical conclusion. In any case, the farther science advances, the less disposed are first-rate scientists to believe that they fathomed the mysteries even of the world of nature, let alone the whole of reality. Their attitude is humble and cautious, not dogmatic and assured.

If my analysis is correct thus far, it follows that science cannot properly deny that there may be meaning and purpose, or even a God, in the universe, though it cannot itself make any such assertions. Responsible belief in God and in a cosmic purpose is possible, however, only if affirmative evidence can be adduced for its support. Without such evidence, moral and religious belief would have to be wholly blind, and I would condemn blind faith as heartily as does Professor Stace. What kind of evidence, then, would be relevant and coercive? On what kind of experience can an enlightened belief in God and cosmic meaning be based?
Consider also the first 3 paragraphs of the outstanding PhD Thesis entitled *An Analysis of Unconfined Ground Water Flow Characteristics near a Seepage-Face Boundary*

**Paragraph 1:**
Ground water flow occurs under conditions that are usually classified as being **either confined or unconfined**. **Confined** ground water flow is… **Conversely, unconfined** flow…
(The structure is clearly signposted by the discourse markers “either - or” and “conversely”, and repetition, in correct order, of the terms “confined” and “unconfined”)

**Because….then** it is imperative that unconfined flow processes can be quantified…
(An argument of cause and effect is signposted)

**Paragraph 2:**
The …quantification of **unconfined flow processes**…
(Repetition of key words indicates continuity to previous paragraph)

**The justification for** ignoring the vertical processes **is that** the horizontal length scale of a typical unconfined aquifer is much larger than the vertical, i.e. L>>H in Figure 1-1. **Therefore**…
(An argument is signposted, and the reader is referred to a Figure that makes the point visually. The consequence of that argument is also signposted.)

**Paragraph 3:**
Several analysts have expressed reservation about horizontal flow modelling strategies; **for example**…**Although** these reservations have been voiced, **other** researchers have shown that… **Therefore**, (A point is made and an illustration signposted. The words “although” and “other” indicate that controversy is being discussed. The word “therefore” signposts an outcome of the controversy or a conclusion.)
Structuring Introductions – 3 Essential Moves

1. Establish a research territory by showing that the research area is important, problematic or relevant in some way and introducing previous work in the area

“How students perceive their learning environments has long been accepted as having a significant influence on the quality of the students’ learning outcomes (e.g. Doyle, 1997; Fraser, 1989; Ramsden, 1992; Walberg, 1971). Over the past quarter century an extensive empirical base…has been developed…The ultimate aim of most of this research has been to…”

(Opening sentences in the Introduction of the following paper: Clarke, J Tertiary Students’ Perceptions of their Learning Environments: A New Procedure and Some Outcomes)

2. Establish a context in which your research makes sense by defining a problem or question that needs to be answered

e.g. “Although (past work described in the preceding paragraph) is psychometrically sound, (it has) a number of potential limitations. First, there is always a concern that….. Second, the instruments (used in measurement) focus on just one type of learning environment…… Third (these instruments) …. may deny the complexity of classroom life. And fourth, the instruments do not investigate why…”

(Clarke, J Tertiary Students’ Perceptions of their Learning Environments: A New Procedure and Some Outcomes)

3. State what you will do in relation to the problem or question by
- outlining the objectives of your research, what do you propose as the solution to the problem identified above
- indicating the structure and scope of the paper

e.g.
“This paper reports on the use of the Perceptions of Learning Environments Questionnaire which uses a semi-structured …format to gather student perceptions…This seeks to address the limitations of existing instruments outlined above. The outcomes of the data collection reported here are used to produce student views of good and bad teaching which are then evaluated in terms of contemporary ideas about effective teaching.”

(Clarke, J Tertiary Students’ Perceptions of their Learning Environments: A New Procedure and Some Outcomes)
**Drafting, Revising, Editing and Proofreading**

References:


A. Drafting

"*In the first draft of your thesis you are really finding out what you know. In a sense, you are writing for yourself, so the first draft is experimental.*" (Elphinstone and Schweizer, 1998 p. 81)

Some “big picture” questions to consider as you write early drafts

1. What is the motivation for this work?
   (What is the “people problem”? what is the “technical/scientific problem”? what are the previous solutions to these problems and why are they inadequate? Why are the variables in my research significant?)

2. What is the proposed solution to the problem (idea, design, hypothesis)? How is it an improvement over past solutions? How will it be achieved?
2. How do I demonstrate that the methodologies used are appropriate to the investigation? How do I reassure the reader that the results are reliable and valid?

3. What are the paper’s contributions – ideas, methods, designs, results, techniques, algorithms, models? Why are the results/outcomes of the research significant?

4. To what extent have the project aims been achieved? What were the limitations of the study?

5. What are the future directions for this research?
B. Revising

“Skilled writers revise constantly, trying to resolve the tensions between what they want to way, and what the sentences actually record. For many skilled writers revising is the crux of the writing process. It is the way they shape prose into meaning for an audience, and the way they discover what they want to say, sometimes to their own surprise.” (Yang, quoted in Elphinstone and Schweizer, 1998, p. 83).

As you revise your drafts, look for weaknesses in:
1. how you have put your argument
   - is the argument clear?
   - do you have a sound grasp of theory?
   - Are your inferences defensible?
   - Do you need examples to illustrate this point?
   - Do you need to use a citation to substantiate this point?
   - Is this a convincing way to use data?
   - Have you answered objections that may be made to your assertions?

2. the structure of the document,
   - Is the basic form and structure of the document suitable? Might it be better with a different layout or a larger or different font?
   - Look at how your thoughts are organised by just looking at your headings and subheadings.
   - Do your headings comprise a hierarchy of ideas that moves from more general ideas to more specific ones?
   - Do the headings accurately predict the content that follows?

   Write headings that give away the information that follows.
   e.g.
Modelling skin colour
An overview of concepts in modelling skin colour
Using colour spaces in model development
Current skin colour models
The effect of ethnicity on skin colour

Test your headings out on someone – is their meaning clear?
You may need to add a few words to eliminate ambiguity.
e.g. compare the value for the reader of the following headings:
“Overview”
“Concepts in modelling skin colour”
“Skin colour”
“An overview of concepts in modelling skin colour”

- Is the existing heading hierarchy suitable, or should there be an extra (or fewer) level of headings?

- Does the document flow well from one section to another, or does it seem disjointed?

- Is the order of the material suitable, or would it be clearer if rearranged?
- Are all abbreviations and contractions spelled out in the text (or a glossary), at least when first used (or when first used in each chapter)?

- Are there terms that need to be defined?

- Are tables and figures placed appropriately, and do they have appropriately worded captions?

- Is the tone and vocabulary of the document suited to its intended audience?

- Is the writing style clear and easily understood?

- Is the writing style wordy, pompous or full of jargon?

- Is there need for additional material such as background information or more detailed information?

- Might the information be more effective if one or more tables or diagrams were added?
3. When revising your drafts, try to read them as a specialist in the field (e.g. an examiner) would.
Mark your draft with the following (or similar) symbols to help with the process of revision.
(?) lack of clarity
(c) check the accuracy of this point
(x) material that could be deleted
(r) repetitive
(e) evidence required
(i) interpretive weakness

C. Editing
“Editing is about getting your text in good shape for your reader” (Elphinstone and Schweizer, 1998 p. 85).

1. the key importance of paragraphs
   (a topic sentence that accurately conveys the point of the paragraph, clear signposting)

2. edit to strengthen your sentences
   a. **Open with sentences that show intensity**
      e.g. “This study was designed to reveal whether the .....approach was a useful was to solve the problem of ...... We (the writer) reasoned that.....”

   b. Use short, well-planned sentences that convey information (ie be concise, avoid padding)

   A sentence is a group of words that makes sense. It comprises a subject, a verb and an object. The **subject** and **verb** should be located close together. The most important information in a sentence should be at the beginning. In general, **the subject** should come before the **verb**.

   Compare:
   “**Using a specially constructed mould**, a method of manufacturing these blocks in quantities sufficient for assembling representative structures, was developed.”

   “**A specially constructed mould** was **used** to develop a method of manufacturing these blocks in quantities sufficient for assembling representative structures.”
c. Over the whole document, make the average sentence length 15 to 20 words.

d. Take particular to punctuate so that your meaning is conveyed accurately.
   e.g. *The lions having eaten the hunters, rested* versus
        *The lions having eaten, the hunters rested.*

e. Use the active voice where possible
   e.g. “Interlocking structures were tested using a loading frame (active)
        A loading frame was used to test interlocking structures (passive)

f. Explain concepts rather than use labels to describe them. Labels are clusters of nouns and adjectives that are not linked or broken up by verbs and prepositions.
   e.g. “In aquatic systems, the phytoplankton space-time distribution is influenced by versus
        “In aquatic systems, the distribution of phytoplankton in space and time is influenced by….”

g. Use the correct tense

You will use the past tense most often in writing your thesis, because you are reporting on events done in the past (i.e. earlier this year), or on the past research of others

   e.g. This *was* a study to determine if....
         Johnson and Smith (2003) *found* that...

Use the present tense for giving a fact or principle
   e.g. Perth *is* in Western Australia
         Children *read faster* as they gain experience

Use the future tense (or future perfect) in proposing a study or some aspect of it
   e.g. I *will use* an algorithm to...
         Analysis of variance *will be used to*...

Use the present perfect tense to refer to ongoing states of mind or actions
   e.g. Lambers *has been arguing that*...
   BUT use the past tense to refer to persons who are no longer active in the debate   e.g. Darwin *argued that*...
h. When using pronouns (it, they, this, these, he), especially at the beginning of sentences, make sure the reader is clear about the noun they are replacing. Avoid ambiguity by making the antecedents of pronouns obvious.
   
e.g. “This formula is correct.” rather than “This is correct.”

D. Proofreading

Checking accuracy and consistency in use of language, in style and layout

- Is the heading hierarchy and heading numbering scheme consistent?
- Are abbreviations and contractions used in a consistent manner?
- Is the formatting of captions in Figures and Tables consistent?
- Have you been consistent in the way you’ve used hyphens?
- Are footnotes formatted in the same way, are they sequentially numbered?
- Is header and footer formatting consistent?
- Have all sources been acknowledged in a consistent way?
- Are there errors of grammar, spelling or punctuation?
- Are page numbers correct?
- Amend any sentences in which the meaning is unclear.
- Update Table of Contents and Table of Figures etc and check that they match the actual content.

Adapted from:
North, T. 2003 e-writing and editing Course notes Part 11, IPAA WA Division
A good thesis has a logical structure, it is concise and is written so that the arguments presented are easy to follow.

Exercise:
Write well structured paragraphs about your research. You may base these around the issues suggested below or you may choose to write paragraphs relevant to your Introduction, your General Discussion or any other part of your thesis.

1. My research addresses the following (overarching) question:

2. The results presented in this thesis show that
3. The consequences of this are: 

   This means that:
Some useful references:


- Flesch, R.F. (1962) *The Art of Readable Writing* (available from the Humanities and Social Science Library, 808.042 Art)


- How to recognise plagiarism [http://www.indiana.edu/~istd/sitemap.html](http://www.indiana.edu/~istd/sitemap.html)


- Murphy, E (1985) *You Can Write* Longman


Version 2 of Introduction to Scientific Paper: better paragraph structure

Various Eulerian link-node models have been developed for the simulation of transport for water quality modelling. For example, Tim et al (2003), Jin et al (1998), Lung and Larson (1995), Gu and Dong (1998) used WASP5 for water quality modelling in rivers and lakes. Barnell et al (2004) and Melching et al (1994) used QUAL2E for river water quality modelling. However, Eulerian models have two major limitations. First, these models contain an undesirably large amount of numerical diffusion in the advection simulation (refs) and are found unsatisfactory (you could be more specific here e.g. "which makes them insufficiently accurate") for transport and water quality modelling. Second, time-step limitations mean that Eulerian models may not be suitable for long term simulations of large river systems.

The Lagrangian frame has the potential to overcome these limitations. First, since control volumes are moved with the mean flow velocity, numerical diffusion associated with advection is totally eliminated and accurate modelling of transport and water quality may be achieved. Second, a Lagrangian model allows a large time-step, thereby allowing for a long-term simulation. (Now make your point about an economic solution).