



Birmingham International Academy

Thesis Writing for Scientists and Engineers

Session 5: Conclusions & Abstract
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Please sit near other people



There is some variation in practice about the inclusion of a conclusion at the end of an article or a thesis. Some theses or articles have a separate section entitled “Conclusion” or “Conclusions” after the Discussion of Results, others do not.

A conclusion normally summarises the main findings reported in the Discussion and will often present a number of recommendations about possible future work.

Where there is no separate conclusion, the final paragraph or paragraphs will summarise the main findings and make recommendations.

You should ask your supervisor whether s/he prefers to have a separate conclusion.



I. Conclusions

**Summarise: don't just repeat for the sake of it
– highlight your key point(s) for a strong 'take-home message'**

A STRUCTURE

This section considers what to include or exclude from the conclusion.

In your conclusion you will summarise your research, and probably remind your reader of the structure that was followed. You are likely to refer back to your findings and some of their implications that were presented in a "Results" or "Discussion" section.

Traditionally, you do not add new information in your conclusion. If you are tempted to do this, consider adding it towards the end of your previous chapter instead.

Here are some of the possible steps in a concluding section:



(a) Report the procedure and/or aims

For example:

This paper analyzed central bank data to determine whether distinct groups of central banks could be identified.

(b) Report findings and claims based on findings

For example:

The students in this study transferred some, but not all, learning skills to the regular classroom. In particular, they appeared to make effective use of self-monitoring skills and to take responsibility for their behaviour, even when these skills were not being demonstrated by their regular class peers.



(c) Suggest how other research supports present findings (or vice versa)

For example:

This injunction is in agreement with an earlier recommendation made by Ladas (1980, p.48), in his discussion on the comparative rates of notetaking, listening, and speaking to American students.

(d) Suggest limitations of procedure or findings

For example:

A limitation of the research presented here is that the number of participants is limited to only 30 students.

(e) Propose implications of the findings

For example:

This study has implications for the teaching of academic writing to international postgraduates.



(f) Make recommendations (usually more specific implications)

For example:

Some of the difficulties of mounting an inservice program in a small and geographically widespread region were examined and this highlights the need for system inservice leaders to be very aware of the demands of the models of implementation in terms of geography, teacher careers and other factors.

(g) Make recommendations about future research

For example:

While the research reported in this study was exploratory in nature, several issues appear to need additional exploration (1, 2, 3 etc).

Even if brief, try to be as specific as you can:
e.g. say how further research will be beneficial



Useful language structures for conclusions

- <http://www.phrasebank.manchester.ac.uk/writing-conclusions/>

To sum up:

- a. Report the procedure and/or aims
- b. Report findings and claims based on findings
- c. Suggest how other research supports present findings (or vice versa)
- d. Suggest limitations of procedure or findings
- e. Propose implications of the findings
- f. Make recommendations (usually more specific implications)
- g. Make recommendations about future research

Note that these stages are quite similar to the stages of a discussion section, although the focus is less on referring back to results, and more on looking at implications for the future.



Task 1

The following are endings of theses at the University of Birmingham. Which of the above steps can you identify?



8.4. Conclusion

a. Report the procedure and/or aims

(a) The thesis has reported the relationship between posture, seating and muscle activity among dentists and dental students.

(b) The dentists and the students using the CS reported here:

- Poor posture increasing the RULA risk scores
- Increase in level of pain through the workday, especially the back, neck and shoulders.
- Increase in muscle activity (percentage MVC) during dental work
- Increased neck flexion angles during dental work contributing to neck pain

(b) The dentists and dental students using the Bambach Saddle Seat followed a pattern opposite to the dentists and dental students using the conventional seat, namely:

- Good posture decreasing the RULA risk scores
- Decrease in level of pain through the workday
- Lower muscle activity (percentage MVC) during dental work
- Neutral neck flexion angles during dental work resulting in lower incidence of neck pain.

(b- **claim/e**) This thesis has established the relationship between posture, seating and muscle activity and indicates that use of an ergonomic aid (dental operator stool) may improve posture, decrease pain and muscle activity and may decrease the development of musculoskeletal disorders among dental students and dentists.

e. Propose implications of the findings



7.4 CONCLUSIONS

b. Report findings and claims based on findings. [...]

(b) In the current study clear improvements were evident. However, variation in treatment inconsistency in clinical practice. (f/g) This variation will now need to be examined using standard population based cancer registration data. (c) The lack of survival advantage, or of a difference in the use of adjuvant therapy according to caseload, is contrary to the recommendation made based on research by the COG. (g) Further work will therefore need to be carried out in this area to assess whether caseload is a valid indicator of high quality care and improved patient outcome.

f. Make recommendations (usually more specific implications)

g. Make recommendations about future research

c. Suggest how other research supports present findings (or vice versa)

g. Make recommendations about future research



B LANGUAGE



1. The language of Recommendations

Task 2

Look at the concluding part of the discussion section from an article about the use of drugs in men and women.

1. Divide the paragraph up into **Conclusion** and **Recommendation**
2. Think up alternative ways of expressing the **Recommendation**

e.g. change
sentence word
order/use
passive

Despite all of the adjustments, the female rate of drug acquisition remains slightly higher especially in younger age groups. Thus, it is likely that both physical and psychosocial factors influence the way in which men and women perceive, label and respond to their needs and symptoms, and the way in which physicians respond to their patients. However, as researchers continue to investigate these issues, it is critical that they collect more objective and detailed data and that they disaggregate the types of patients, diseases, symptoms and drugs being investigated.



KEY

Conclusion:

Despite all of the adjustments, the female rate of drug acquisition remains slightly higher especially in younger age groups. Thus, it is likely that *[notice the cautious language]* both physical and psychosocial factors influence the way in which men and women perceive, label and respond to their needs and symptoms, and the way in which physicians respond to their patients.

What should be done

Recommendation:

However, as researchers continue to investigate these issues, it is critical that they collect more objective and detailed data and that **they disaggregate the types of patients, diseases, symptoms and drugs being investigated.**

Why this should be done – How will this help move research forward?

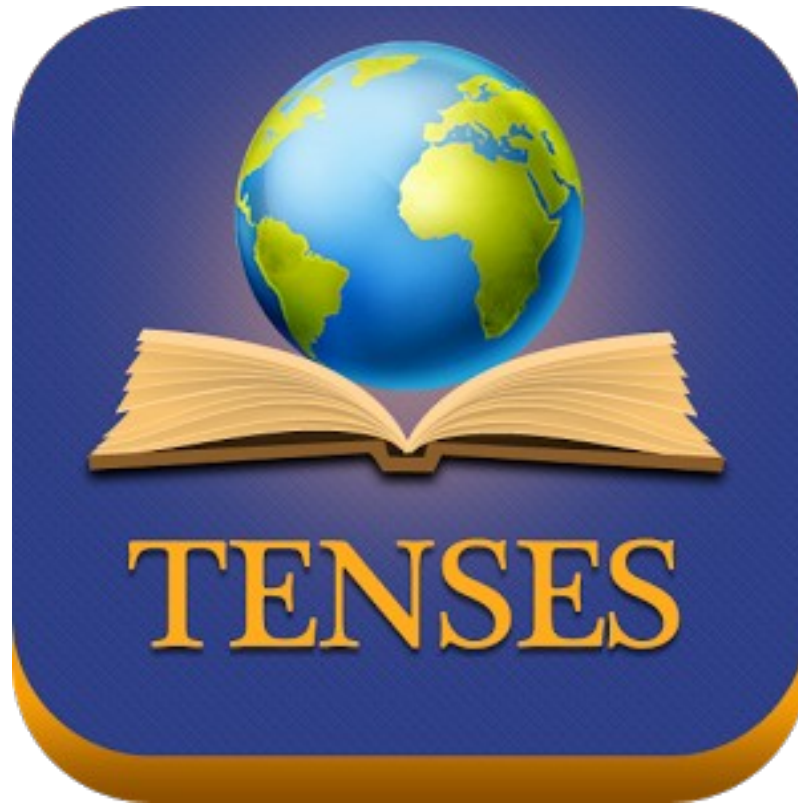


Suggestions

- a) In future studies **more objective and detailed data should be collected** and the types of patients, diseases, symptoms and drugs being investigated **should be disaggregated**.
- b) More work needs to be done in this area; data should be collected more objectively, and the types of patients, diseases, symptoms and drugs being investigated **need to be disaggregated**.



Those annoying verbs again...



2. Tense use in conclusions

Task 3

Now look at this conclusionⁱⁱⁱ. How many different tenses can you find? Can you justify their use? Which one is used most, and why?

The dominant tense in the conclusion is mainly the simple present, as the writer presents the results as facts based on evidence and support within the thesis.



- Two new analyses of steady-state operation of the Class E power amplifier **have been presented** [1. **present perfect (passive), links past time (the writing) with the present (the presentation of the writing)**] in Chapter 3.
- They **use** [2. **simple present, fact about the analyses**] different techniques and apply to different, but overlapping, domains characterised by circuit Q and normalised carrier frequency. Both analyses **extend** [2] existing theoretical knowledge of the circuit and **provide** [2] useful information for practising electronic engineers who wish to design a Class E amplifier.
- The key findings from the first (power series) analysis **are** [2] expressions for component values for finite Q circuits, and an estimate of the unwanted harmonic output.
- These **were** previously only **known** [3. **simple past (passive), at a time before this study**] from numerical solutions at spot values of Q and frequency.



- The existence of the power series solution **confirms [2]** that exact Class E conditions **are [2]** possible for finite Q , but no longer **coincide [2]** with peak efficiency. This analysis also **gives [2]** expressions for the carrier frequency response, but for most purposes these **are [2] superseded** by those obtained by considering energy conservation. Finally, the power series analysis **gave rise to [4. simple past, describing the procedure, what the researcher did]** the insight that the role of the drain feed choke **is [2]** simply to feed a current into the rest of the circuit; this then **led [4]** to the amplitude modulation theory **given** in Chapter 4. **[= that was given/that has been given]**



- The significant results from the second (energy conservation) analysis **are** [2] simple rational functions giving the frequency response of the Class E PA over the entire central region. This fills [2] a long-standing knowledge gap, which **may** [hedging] **have** seriously **limited** [1. past modal form, describing the result of something that happened in the past] the practical usefulness of this circuit.
- ...The expressions from the first analysis **provide** [2] results which agree with published numerical solutions. The findings of the second analysis **agree** [2] with published solutions and measured data.



A Typical Pattern

Present perfect (this thesis has discussed...)

[sometimes simple past: The previous chapters presented...]

Simple Present (the findings show...) with some hedging (this may be ...)

[main claims]

Future (further investigations will need to be done)

[Sometimes present: More research is needed in order to...]



Your research is brilliant but...



3. Cautious language in conclusions

The following revision is taken from an Abstract by a postgraduate student of chemical engineering:

Original	Revision
In conclusion, this study is a useful first step in the development of biodegradation techniques.	In conclusion, it is hoped that this study may be a useful contribution to the development of biodegradation techniques.

Two principles of Academic Modesty are broken by the original drafting:



1. Do not praise your own work.

As an academic writer, you may describe the work of other people as valuable, useful, interesting, etc: however, you may not describe your **own** work as valuable, useful, interesting, etc. The closest you may come to such a statement is to express the **hope** that the work is valuable, useful, interesting, etc. (i.e. the judgement is for others to make, not you).

2. Show that you understand the limitations of your work.

In the present case, any non-expert knows that previous work has been done on biodegradation techniques: so clearly this cannot be a “first step” for science (though it was, clearly, a first step for the student).



II. Abstracts

At the beginning of your thesis you will normally be required to write an **abstract**.

Discuss with a partner:

- **What is the main function of an abstract ?**
- **What is the difference between an abstract and the introduction?**

An abstract may also be referred to as a **synopsis** or **summary**. There are often regulations on how long the abstract should be. It usually has to be somewhere between 100 and 300 words.



LISTEN AND COMPARE IDEAS

- <http://writing.ucdavis.edu/sciencewriters/uwp.html>
- “I should be able to give anybody the abstract and they should be able to understand it, even if they are not an expert in the field.”



Check with your supervisor if you are in any doubt and remember that the best way to familiarize yourself with the abstract style in your discipline is to read examples!



A STRUCTURE

Read this abstract^{iv}:

Background	Disciplinary variation in academic writing has been explored for the most part by comparing a particular genre, such as the research article, across disciplines. However, genre theorists have not systematically studied relationships among related genres.
Aim	It is argued in this article that a study of relationships among related genres from different disciplines can inform us about the differences in academic writing across disciplines.
Method	The generic structure of research article introductions and abstracts, which form a genre set, from two related fields, Conservation Biology and Wildlife Behaviour, was compared.
Main findings	Findings indicated that research article introductions and abstracts in Conservation Biology bear a greater similarity in function and organisation than the same two genres in Wildlife Behaviour.
Conclusion	This study reveals that disciplinary variation in academic writing is not manifested in generic structure but also in the relationship among genres.

Notice that the abstract can be broadly divided into the following steps:

- (a) background (including an indication where there is a 'gap' in our present understanding or ability)
- (b) the aim or purpose of the research
- (c) the methods used
- (d) the main findings
- (e) a conclusion or comment on previous research

NOTES

Note: some abstracts give you actual results, e.g.

the optimum sulfur dioxide reaction time was found to be 300 ° F (149 ° C)

Others just tell you what results are reported in the article without giving figures, e.g.

Effects of the sphere diameter and the thermal properties on the quench boiling curves were found.

It is rare for abstracts to include citations. They may, however, refer to seminal works (key research with which the current research is compared. An abstract may also include a citation if the thesis extends or significantly contradicts the research cited.



Task 4

Here are some more abstracts^v. Try to divide them into the sections listed above by inserting (a)-(e).

Note that the sections may be in a different order, and you will not be able to find all of them for each abstract.

- (a) background (including an indication where there is a 'gap' in our present understanding or ability)
- (b) the aim or purpose of the research
- (c) the methods used
- (d) the main findings
- (e) a conclusion or comment on previous research



(a) It is often assumed that women received more prescribed drugs because they have different attitudes towards illness and medical care, high anxiety and more time to visit physicians, or because physicians are biased. (b) This study examines an alternative explanation, that is, much of the excess is associated with women's reproductive role. (c) The study involved a detailed audit of the medical and pharmacy records of 862 men and women. (d) Results showed that women received more prescribed drugs during the 2-year study period. However, the differences between men and women were not the same for all age-groups. As expected the differences were most apparent during the peak child-bearing years. Further analysis showed that the gender differences were virtually eliminated after excluding women with female-specific diagnoses and excluding the drug categories used to prevent or treat female-specific conditions. (e) Previous studies based on gross measures of self-reported drug use seem to have underestimated the importance of factors that relate to women's reproductive role.

Abstract 1



(b) Atomic absorption (AA) analysis was employed to determine (a) for the first time in this country, lead concentrations in aerosols (c) collected in Nuclepore filter media during the months of February and March (1980) in Guatemala City, Guatemala. (c) In particular, the lead in the atmospheric fine particulate was measured in different downtown locations around noontime and in a single location at 1-h intervals throughout the day. (b) The first was used to study short-term variations from one location to the other, and the second one was used to correlate parameters such as traffic density and wind velocity with the levels of airborne lead on the same day. (b) In addition, this paper presents a brief discussion of the lead content in Guatemalan gasoline, the lead levels in street dusts, and the total suspended particulate matter in downtown Guatemala City.

Abstract 2



Task 5

Here are some more abstracts of dissertations. The paragraphs are in the wrong order. Can you put them back where they belong?



KEY

- Correct order abstract 1:
- 2-4-3-1
- Correct order abstract 2:
- 4-3-5-1-2



B LANGUAGE

Task 6

Write in the correct verb forms of the verbs in brackets in the abstract^{vii} below:

Hint: One form is passive! *Most* forms are present tense.

This thesis (1) _____ (**describe**) the research and development into a range of time-temperature integrators (TTIs) for the measurement of process values for food heat treatments. The TTIs (2) _____ (**base**) on the first order thermal degradation of bacterial α -amylases. Two new TTIs are described, one for mild pasteurisation treatments of a few minutes at 70°C and one for full sterilisation of >3 minutes at 121.1°C. Examples are given of how these TTIs are applied to a variety of industrial thermal processes. These (3) _____ (**include**) traditional methods such as canning, but also more complex systems such as tubular heat exchangers and batch vessels, together with novel systems such as ohmic heating. Some of the industrial experiments (4) _____ (**deal**) with processes in which the thermal effects (5) _____ (**not be**) _____ previously quantified.



KEY

- This thesis 1. **describes** the research and development into a range of time-temperature integrators (TTIs).
- The TTIs 2. **are based** on the first order thermal degradation of bacterial -amylases.
- These 3. **include** traditional methods such as canning, but also more complex systems such as tubular heat exchangers and batch vessels, together with novel systems such as ohmic heating.
- Some of the industrial experiments 4. **dealt** with processes in which the thermal effects 5. **had not been** previously quantified.
- This microorganism 6. **exists** in extreme conditions where it 7. **metabolises** in boiling volcanic pools; with elemental sulphur readily available, in water of high salinity, and in a reducing atmosphere.



How is a thesis like a good meal at a restaurant?

Starter

*Pan fried scallops with cauliflower pure crispy
prosciutto and sweet corn sauce.*

Main

*Lamb shoulder with red cabbage, mint new potatoes
and red wine jus.*

Dessert

Crème brulee with a touch of Szechuan pepper.



AN ABSTRACT SUMMARISES AND CONDENSES SO THAT A NON-EXPERT CAN UNDERSTAND WHAT YOU DID AND WHY



AN INTRODUCTION STARTS THE TEXT, CONTEXTUALISES &
GUIDES THE READER TOWARDS THE REST OF YOUR
RESEARCH



CONCLUSIONS END THE TEXT BUT CONNECT YOUR RESEARCH TO THE OUTSIDE WORLD

