Chapter 13

Writing the introduction and literature review

> The measure of greatness in a scientific idea is the extent to which it stimulates thought and opens up new lines of research.
>
> Paul Adrien Maurice Dirac
> *The Scientific Work of Georges Lemaître, 1968*

The *Introduction* is the first chapter of the report or thesis and its chief function is to familiarise the reader with your research problem and the relevant literature. The literature review may be a section within the *Introduction* or written as a separate chapter following the *Introduction*. The *Literature Review* as a separate chapter is a more in-depth counterpart of the literature review section within the *Introduction*. In a thesis, the *Literature Review* as a separate chapter is usually the norm.

This chapter provides guidance on writing the *Introduction*. First, the components of an introduction will be described. This will be followed by a discussion of the common logical missteps committed by writers and, finally, the language features that you can use to enhance your writing will be highlighted.

COMPONENTS OF AN INTRODUCTION

The *Introduction* essentially comprises the following three basic components:

1. Establish key ideas and findings of research literature and/or real-world context relevant to your research topic.
2. Present a research problem.
3. Announce how you will specifically address or fix the research problem.

These components are further broken down into steps as shown in Writing Guidelines 13.1. The components and steps are based on a synthesis of the research findings on how introductions are written from the work by Swales (1990, 2004), Bunton (2002) and Samraj (2004, 2008) as well as our analysis of engineering reports and theses.

Writing Guidelines 13.1 Components of *Introduction/Literature Review*

Component 1: Establish key ideas and findings of research literature and/or real-world context relevant to your research topic

A. Indicate importance/recency of relevant literature (very frequently used)
B. Indicate claims based on research (citing and reviewing research) or common knowledge (very frequently used)
C. Define terms and constructs in your research that are not frequently used (infrequently used)

Component 2: Portray a research problem of uncertainty

One or more of the following statements can be used:
A. Argue for a real-world problem or need (very frequently used)
B. Argue that no research was conducted on your topic (frequently used)
C. Argue that scant research was conducted on your topic (very frequently used)

Component 3: Announce how you will specifically address or fix the research problem

Two or more of the following statements are used:
A. State the aim/purpose/objective of your research (very frequently used) and/or describe theoretical and/or real-world contributions of your research (frequently used)
B. State research question or hypothesis of your research (frequently used)
C. Summarise the research design/method of your research (frequently used)
D. State key findings of your research (infrequently used)
E. Indicate scope/parameters of your study (infrequently used)
F. State explicitly the significance or value of your research (infrequently used)
G. Outline the structure of all sections subsequent to the introduction (very frequently used)

In Component 1, share with the reader the key concepts and findings from previous research that are related to your research topic. In other words, you need to situate your research in the wider context of research and/or the real world. In a way, Component 1 reflects the expectation of the reader that your research topic is developed from links to previous research and not formulated in vacuum or isolation. There are three steps in Component 1:

Step A: Statements about the importance or centrality of your research topic in research and/or the real world. You can claim importance directly or indirectly. You can claim importance directly by stating the importance or significance of your research topic (e.g. 'Indeed, the search of natural compounds and management methods alternatives (or complements) to classical pesticides and fungicides has become an *intense* and *productive* research field'). Note the keywords in italics which explicitly declare the importance of the research area. Alternatively, you can claim importance indirectly by stating the high frequency and recency of the research done (e.g. 'In *recent* years there has been a *significant, resurgent interest* in renewable energy sources').

Step B: Stating a knowledge claim which can be an established fact or a controversial finding. You may or may not substantiate a claim with an in-text citation (see *Chapter 18—Referencing, in-text citations*). If there is no in-text citation to back up a claim stated in your report or thesis, it must be supported by common knowledge and is, therefore, unlikely to be challenged by the reader. For example, a claim that states that all fossil fuels are finite resources is a fact which does not need to be supported by cited studies because it is deemed to be common knowledge by academic readers. If the claim is controversial, support it by citing empirical sources. For example, a claim that alleges that nuclear energy is the best sustainable energy source is controversial and needs to be supported by cited scholarly sources.

Step C: Definitions of technical terms and theoretical constructs in your research.

Component 2 is another indispensable component in the *Introduction* and *Literature Review*. It usually follows Component 1, after the establishment of the most relevant research/real-world context to your research topic. However, Components 1 and 2 can be intertwined with statements belonging to either part.

Component 2 sets the stage for the justification of your research topic as a useful study in the wider context of research and/or the real world by portraying a research problem of uncertainty—this specific research uncertainty is your research topic. Your research topic should be narrowly framed or defined, particularly in a report or thesis with a strict word limit. Notably, the language used in portraying a research problem is usually negative and contains words and expressions such as *suffer from weaknesses, can work only, none of, no, not, fail and inconclusive*. The claim that your research topic is justified as previous research fails to establish certainty can be done in three steps:

Step A: In this step, you 'argue for a real-world problem or need'. This is the most common approach used by engineering writers—expectedly so as engineering is closely applied in the real world. An example sentence is, 'To reduce heavy reliance on herbicides and fungicides, there is *a need* to move to low-input sustainable agriculture as a component of integrated weed and fungi management.' Step A is usually accompanied by knowledge claims (Component 1, Step B) which furnish key supporting details underlying the real-world problem or need.

Step B: Here you argue for a research gap that is neglected which your study will fill. An example sentence is, '*However*, *no* information is available about its antifungal activity.' Negative language is marked in the use of *no* and implied in the logical connector, *however*.

Step C: You argue for a problem of research insufficiency or inadequacy. Before a finding can be established as a fact, empirical science requires

that a critical mass of experimental studies corroborate it. Insufficient or inadequate research can be argued on the basis that this scientific consensus has not been reached or achieved. An example sentence is, 'While there have been numerous studies examining the biomechanics of typing for body postures, head postures, arm postures, and wrist postures, there have been *only three* studies (Baker et al., 2007; Sommerich et al., 1998, 1996) that have looked at the postures and actions of hands and digits during standard keyboard use.'

Component 3 is the concluding component that explicitly states how your research addresses or fixes the research problem stated earlier. This component is accomplished in seven steps, steps A–G explained below.

Step A: Statements of your research aims, objectives or purposes, or a description of theoretical and/or real-world contributions of your study. An example of stating your research aims, objectives or purposes is, 'This study compared the kinematics of the digits during typing on a standard keyboard configuration and an ergonomic keyboard configuration *to determine* if an ergonomic keyboard configuration reduced the digit postures and motions that are hypothesised to be risk factors for MSD-UE.' The keywords (to + verb infinitive) in italics indicates the purpose of the study. An example of describing theoretical and/or real-world contributions of your study is, 'The present work *extends* the use of the last model to asymmetric, body-vortex flow cases, thus *increasing* the range of flow problems that can be investigated.' Note that the language used is positive, as indicated by the words in italics.

Step B: Statements of research questions or hypotheses are made. Research hypotheses are hedged statements* of best guesses of your research problems based on what past findings can glean. An example of research hypotheses is (note the cautious words in italics), 'The following two hypotheses were examined: (1) participants using the ergonomic configuration *would* demonstrate significantly more neutral joint angles, slower joint angle velocities and reduced joint angle accelerations at the metacarpophalangeal (MCP) joint (flexion/extension and abduction/adduction) and proximal interphalangeal (PIP) joint (flexion/extension) compared to using the standard configuration; (2) participants using the ergonomic configuration *would* demonstrate greater hand displacements compared to using the standard keyboard.'

Step C: Summary of the research design especially when the research method is the central novelty of a research project.

Step D: Component 3 can also include a statement on the key findings of your research, such as 'The estrone-adsorbing capability of

* 'Hedged statements' are statements of uncertainty.

nylon membranes, as reported in this study, *can augment* their solids removal functions by providing simultaneous treatment for source water that contains elevated levels of estrone. A *unique* feature of this method is that it can operate at low pressures as it is driven by a chemisorption mechanism and *does not* rely on size exclusion.' Note the words in italics which signal the importance of the findings.

Step E: The parameters or scope of your research study can be indicated as a part of Component 3.

Step F: This step is a bold proclamation of your study's research or real-world worth such as 'The synthesis strategies of both mesoporous carbon and Pt/GMPC *are facile and effective*.'

Step G: The last step of Component 3 is a content primer which briefly summarises the contents of subsequent sections of the report, such as 'A brief summary of leading approaches to the first two questions *will* be described, *followed by* a general description of how proposed approaches employing nanoscale structures are capable of answering the third question.' The modal verb 'will' and the verb + preposition phrase 'followed by' indicate the sequence of information after the introduction.

STRATEGIC USE OF STEPS IN THE DIFFERENT PARTS OF AN INTRODUCTION AND LITERATURE REVIEW

In writing the first draft of your research proposal, literature review or introduction of your report or thesis, the three components described above should be presented briefly. Scope-wise, Component 1 is most general in covering relevant literature, followed by Component 2 which narrows in on a problem of uncertainty which is your research topic. Component 3 specifically spells out how you will address your research topic. In Component 1, Steps A and B are frequently used and should be present in your writing. Step C (supplying technical definitions) is less frequently employed.

In Component 2, the number of steps used depends on the word length of your report or thesis. If your report or thesis is short, say less than 3,000 words, it is likely that you will choose only one of the three steps as your research problem. If you have more word space, you may use more than one step in Component 2.

Component 3 comprises an assortment of steps from which you can pick and choose as a writer. Note that the most important and frequently used steps in Component 3 are Steps A (state the aim/purpose/objective of your research) and G (outline the structure of all sections subsequent to the introduction). Writing Guidelines 13.2 presents an analysis of the contents of two sample introductions. The component as well as the step within the component that each sentence shows is indicated in brackets.

Writing Guidelines 13.2 Content analysis of two sample introductions

Example 1: Abstracted from Cheng and Leong (2014)

Determination of small strain parameters like shear modulus (G) and damping ratio (ξ) are frequently carried out with advanced geotechnical tests like the resonant column, the cyclic simple shear and the cyclic triaxial tests **(1B)**[a]. Both the cyclic simple shear and cyclic triaxial tests have been included in testing standards and hence been widely used in the industry **(1B)**. Another popular test to determine small strain parameters is the wave propagation test using bender/extender elements **(1B)**. The bender/extender elements are able to determine small strain parameters at strains smaller than the resonant column and cyclic triaxial tests (Das, 1993) **(1A)**. The wave propagation test has the further advantage of being incorporated into testing apparatuses like triaxial apparatus, resonant column and simple shear apparatus **(2A)**.

While most research had focused on the determination of the stiffness modulus especially the shear modulus, material damping ratio is seldom investigated **(2B)**. This paper explores two methods of determining damping ratio using the bender element tests **(3A)**. The two methods are the Logarithmic Decrement and the Spectral Ratio Method **(3E)**.

Example 2: Abstracted from Wijaya and Leong (2014)

Climate and groundwater table has a major role in causing a soil to be saturated or unsaturated (Fredlund and Rahardjo 1993) and therefore cause the soil to undergo swelling or shrinking (Kim et al. 1992) **(1A)**. Jones and Holtz (1973) reported that the cost of damages to houses, buildings, roads and pipelines due to shrinking and swelling of soils caused is twice as much as the cost of damages from floods, hurricanes, tornadoes and earthquakes in US **(1A)**. Therefore considerable research efforts have been placed on predicting shrinkage and swelling of soils **(1A)**. Several factors which have been considered to influence the shrinkage properties of the soils are the soil structure, the initial water content, the type of clay mineral, the clay content, the organic matter content, the kind and concentration of the cation of the pore water and the drying conditions (Japanese Geotechnical Society 2009; Umezaki and Kawamura 2013) **(1B)**.

Nelson and Miller (1992) listed at least four techniques that are used to predict the shrinkage and swelling behaviors of soils which are the consolidometer test without suction measurement (ASTM D3877, 2008; ASTM D4546, 2008; ASTM D4829, 2011), consolidometer test with suction measurement (Fredlund and Morgenstern 1976), constructing the shrinkage curve (Hamberg 1985) and empirical procedures (Schneider and Poor 1974; Van der Merwe 1964) **(1B)**. Empirical procedures may not be accurate as they depend on the assumptions which were used to develop the procedures while consolidometer test without suction measurement gives only the maximum swelling/shrinkage potential **(2E)**. When suction measurement is performed, it is possible to obtain the change in swelling/shrinkage due to the change in matric suction **(2C)**. However, it requires additional equipment such as a high-capacity tensiometer (Guan and Fredlund 1997; He et al. 2006; Ridley and Burland 1993; Ridley and Burland 1999; Tarantino and Mongiovi 2002) **(2A)**. Constructing the shrinkage curve is the easiest method to predict the amount of swelling and shrinkage and it requires the least equipment **(2A)**. Therefore, the objective of this paper is to construct the shrinkage curves of different types of soft soils **(3A)**. Several shrinkage curve equations which are considered to have high accuracy were used to represent the shrinkage curves data **(3C)**. The comparison between different shrinkage curve equations is then used to give recommendation on the most suitable equation to be used **(3C)**.

[a] Bracketed term at the end of each sentence indicates a step, for example **(1B)** indicates step B of Component 1, **(2D)** indicates step D of Component 2 and so on as shown in Writing Guidelines 13.1.

COMMON LOGICAL PITFALLS IN AN INTRODUCTION

It is important that you substantiate every claim that you made which is not based on common knowledge with in-text citations. In other words, a claim that is potentially contestable should be backed up by empirical evidence.

If you support a general claim with one citation, this may not be deemed sufficient evidence to reduce serious objections from the reader. For example, if you made a debatable claim that girls are better than boys in mathematics and backed it up with one study, the evidence may be deemed insufficient because of the controversial nature of the claim. Readers may infer that this is a case of sweeping generalisation or overgeneralisation based on only one study's findings. Also, if the reader is aware of counter-evidence from other studies, you may be perceived as cherry-picking evidence to support a biased view. Such pitfalls can be avoided if you conduct a thorough and critical literature review.

SOME KEY LANGUAGE FEATURES OF AN INTRODUCTION AND LITERATURE REVIEW

Verb tenses

Verb tense is traditionally used in the temporal sense to locate an event in time, past or present. However, verb tense in the *Introduction* can also be used rhetorically, or persuasively. In Component 1, present tense and present perfect tense are used to indicate that a claim (Steps A and/or B) is a 'generally accepted truth'. When you cite and review research in Component 1 Step B, the present perfect tense and the past simple tense are used. If you are describing research on a specific phenomenon that is collectively conducted over time until the present, then the present tense should be used. If you are referring to a study's research objectives and/or findings, the simple past tense should be used (Bitchener, 2010). See *Chapter 10—Grammar, punctuation and word usage guide* for a more detailed explanation of tenses.

Evaluative words

Evaluative words are used to indicate your position or evaluation of an idea. Cautious words such as *may, can, and probably* indicate a level of uncertainty towards what you have read. Hyland (2000) states that cautious words are used for the following reasons:

- You are uncertain about what you said or read.
- You want to make clear that you are only presenting your opinion.

- You are certain about what you are claiming but want to be seen as modest or show deference to your reader.
- You acknowledge that readers may have reservations about your claim.

Although a cautious word weakens a claim, the weakened claim is less vulnerable to objections because the reader cannot deny your weakened claim. However, even after you have weakened a claim, you may need to elaborate on one or two alternatives or objections and evaluate them, especially if you anticipate that your reader will require more information.

WRITING THE LITERATURE REVIEW AS A SEPARATE SECTION OR CHAPTER

In a thesis or report, the *Literature Review* is usually a section or a chapter on its own. Sometimes, a journal paper may also have a literature review as a separate section. The *Literature Review* on its own is more informative than writing the literature review as part of the *Introduction*. The *Literature Review* serves to provide the link between your research and previous research. Most importantly, the literature review enables you to gain a perspective of your research topic, and helps you to avoid duplicating research efforts and to identify unforeseen problems. Therefore, the contents of a *Literature Review* should include the following:

1. Relevant account of all research and theories relevant to your topic
2. Historical development of your topic if your topic is not entirely new
3. Links between the various research areas and identification of the research gaps
4. Summary of all methods, analyses and techniques relevant to your topic
5. Identification of how your research can contribute to the existing knowledge

A good literature review needs to be critical, that is, you have to take a stand on the issues. It should not just be a description of past research work but an analysis of past research and how it is linked to your research topic. Any criticism needs to be substantiated by a balanced evaluation, it should not be cherry-picking of research work that is 'favourable' to your view. An unbalanced or biased literature review can be easily sensed by the reader.

The literature review is an ongoing process during your research up to the point in time that you are writing it up. There has been anecdotal accounts of PhD candidates who have to redo their research because someone else has beaten them to it. It is thus important to keep abreast of the latest

developments in your research topic. Therefore, make literature review, both reviewing others' work and writing the literature review, a regular part of your research work. The following are tips on writing your literature review:

- Identify keywords in your research topic.
- Use the keywords to identify publications most relevant to your research topic. You can start with about 10 publications.
- Read the abstract of the identified publications and zoom in to the information that is most relevant to your topic.
- Take notes and compile the information as a summary list in chronological order.
- From the summary list, identify common ideas and form linkages between the publications.
- Write the first draft of the literature review based on the 10 publications.
- Add on to the literature review over time as you read more publications as your research progresses.

CHECKLIST FOR INTRODUCTION AND LITERATURE REVIEW

Do your introduction and literature review include the following:

- ☐ Key findings of studies situated within the research field of your topic?
- ☐ Arguments for a research problem of uncertainty which you will address in your study?
- ☐ Statement of your research objective or aim?
- ☐ A list of research questions which your study aims to address?

INTERESTING FACTS

Louis de Broglie's 1924 doctoral thesis titled 'On the Theory of Quanta' consists of only 70 pages, but it revolutionised quantum theory by theorising that electrons and all other matter have wave-like properties. After Clinton Davisson and Lester Germer confirmed de Broglie hypothesis empirically in 1927, de Broglie received the Nobel Prize for Physics in 1929.

REFERENCES

Bunton, D. (2002). Generic moves in PhD theses introductions. In J. Flowerdew (Ed.), *Academic Discourse* (pp. 57–75). Harlow: Longman.

Hyland, K. (2000). *Disciplinary Discourses: Social Interactions in Academic Writing*. London: Longman.

Samraj, B. (2004). An exploration of a genre set: Research article abstracts and introductions in two disciplines. *English for Specific Purposes* 24: 141–156.

Samraj, B. (2008). A discourse analysis of master's theses across disciplines with a focus on introductions. *Journal of English for Academic Purposes* 7: 55–67.

Swales, J. (1990). *Genre Analysis: English in Academic and Research Settings*. Cambridge: Cambridge University Press.

Swales, J. (2004). *Research Genres: Explorations and Applications*. Cambridge: Cambridge University Press.

ADDITIONAL READING

Note that the quotes used in this chapter were taken from the following engineering research articles:

Baker, N. A., Cham, R., Hale, E., Cook, J., & Redfern, M. S. (2007). Digit kinematics during typing with standard and ergonomic keyboard configurations. *International Journal of Industrial Ergonomics* 37: 345–355.

Cheng, Z. Y., & Leong, E. C. (2014). Effect of confining pressure and degree of saturation on damping ratios of sand. In N. Khalili, A. R. Russell, & A. Khoshghalb (Eds.) *Unsaturated Soils: Research & Applications* (Vol. 1, pp. 277–282). Proceedings of the 6th International Conference on Unsaturated Soils, UNSAT 2014, Sydney, Australia, 2–4 July 2014. CRC Press: London.

Han, J., Qiu, W., Hu, J., & Gao, W. (2012). Chemisorption of estrone nylon microfiltration membranes: Adsorption mechanism and potential use for estrone removal from water. *Water Research* 46: 873–881.

Haouala, R., Hawala, S., El-Ayeb, A., Khanfir, R., &, Boughanmi, N. (2008). Aqueous and organic extracts of *Trigonella foenum-graecum* L. inhibit the mycelia growth of fungi. *Journal of Environmental Sciences* 20: 1453–1457.

Leong, E. C., Widiastuti, S., Lee, C. C., & Rahardjo, H. (2007). Accuracy of suction measurement. *Geotechnique* 57(6): 547–556.

Tsakalakos, L. (2008). Nanostructures for photovoltaics. *Materials Science and Engineering R* 62: 175–189.

Wijaya, M., & Leong, E. C. (2014). Modelling shrinkage behavior of soft soils. In *Proceedings of Soft Soils* (Vol. 2, pp. C6.1–C6.6), Bandung, Indonesia, 20–23 October 2014.