# Academic writing – practical tips

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adapted from

Anderson, G. (2014). http://www.bates.edu/biology/student-resources/resources/

Grift, Y., Polzin, F., & Sanders, M. (2024, January 10). *Master thesis manual*. U.S.E. Utrecht University.

# Preface

A critical aspect of the scientific process is the reporting of new results in scientific journals in order to disseminate that information to the larger community of scientists. Communication of your results contributes to the pool of knowledge within your discipline (and others!) and very often provides information that helps others interpret their own experimental results. Most journals accept papers for publication only after peer review by a small group of scientists who work in the same field and who recommend the paper be published (usually with some revision).

The format and structure presented here is a general one; the various scientific journals, and oftentimes specific disciplines, utilize slightly different formats and/or writing styles. Mastery of the format presented here will enable you to adapt easily to most journal- or discipline-specific formats. While this guide (and others like it) is possibly a useful tool in learning the scientific writing style and format, it is not sufficient by itself to make you an accomplished writer. This guide will not teach you how to write in the English language, i.e., it is not a grammar book. You, the writer, must practice writing and thinking within this structure, and learn by example from the writings of others; learning the nuances of this style and format will be enhanced as you read the scientific literature – pay attention to how professional scientists write about their work. You will see improvement in your own scientific writing skills by repeatedly practicing reading, writing, and critiquing of other's writing.

**All** journals have a set of instructions for authors which explicitly state how their paper should be formatted for submission. Above all, remember to write with precision, clarity, and economy.

# Getting Started

The first task to accomplish as you begin the process of writing is to order and organize the information you wish to present. Some people work well from an outline, others do not. Some people write first to discover the points, then rearrange them using an after-the-fact outline. Whatever process you may use, be aware that scientific writing requires special attention to order and organization. Because the paper will be divided into sections, you need to know what information will go into each. If you don't normally work from an outline, this may be an occasion when you'll at least want to develop a list of the major points to be included in each section, before you begin to write. If the paper has multiple authors, then this is a good time to work (and negotiate!) with your collaborators to insure that all the points the group wants to make get listed.

 **Keep in mind your audience**: Who will be reading your paper? Usually you will be writing to your peers. Simple advice: pretend to address your paper to another interested education student, or group, in this course, and assume they have at least the same knowledge and expertise base as you. Knowing your audience helps you to decide what information to include--you would write a very different article for a narrow, highly technical, disciplinary journal vs. one that went out to a broad range of disciplines. Do not write your paper specifically for your supervisor.

## 1. PROSE

Your writing should be in complete sentences and easily understood. It should conform to the conventions of standard written English (sentence form, grammar, spelling, etc). Your ideas will have little impact, no matter how good the research is, if they are not communicated well. Remember always that scientific terminology very often has precise meaning. Be certain you choose your words correctly and wisely. [See Appendix for tips]

It is important to write clearly and concisely. Make sure that every paragraph has a clear topic sentence and that the paragraph content supports the topic. The goal is to report your findings and conclusions clearly, and with as few words as necessary. Your audience (other scholars usually) are not interested in flowery prose, they want to know your findings.

Be proud of your work and humble about its implications. **The reader is always right**. If the reader fails to get your brilliant ideas, it is your responsibility to improve your text. You need to decide on what you want to say and convince/seduce the reader to pay attention and read on. Always ask peers for (critical!) feedback on your work before you submit anything. You become blind to your often small but stupid and annoying mistakes. Respect the reader and present them with the best you got. Think about what (critical/negative) feedback really means. Never take it personal if

it is harsh. Never think it is ok to ignore if it is mildly formulated. It is often your text failing to convince or bring across what you wanted to bring across and that is always a problem.

Remember you want the reader to read your text. The reader never asked you to write it. More important than the page/word limit is that you should never write more or less than you need to make your point. An article/a paper is not your life's work and it is not intended to show everything you have done. It is a report on a worthwhile research project/step that communicates the most relevant and interesting results in a compelling and convincing way. So, keep it interesting!

 **Remember**: Writing and thinking are closely linked enterprises – many people have noted that, "fuzzy writing reflects fuzzy thinking". When people have difficulty translating their ideas into words, they generally do not know the material as well as they think.

## 2. STYLE CONSIDERATIONS

Be **clear** and **concise**: Write briefly and to the point. Say what you mean clearly and avoid embellishment with unnecessary words or phrases. **Brevity** is very important. Use of the active voice alone shortens sentence length considerably. **Precise** word use is critical: Scientific terminology carries specific meaning – learn to use it appropriately and use it consistently. A critical function of technical terminology is to say a lot with a few words, i.e., **economy**. This applies as well to appropriate acronyms and abbreviations. Direct your paper toward the average reader in your intended audience. If writing for a highly technical journal, you will necessarily use the technical jargon. If writing for a general science audience you would limit the jargon. In general, avoid the overuse of acronyms: we do not want to weave through chemistry formulae.

Reader-oriented writing means that you should not discuss well-known trivialities too much. There is a certain pool of knowledge that can be assumed the reader has. Other authors show what makes up this pool of knowledge. Therefore: write little about the general (often what is written in textbooks) and spend more time on the subject of the study (often what is written in journals).

 The author's own learning process during the writing can disturb the reader orientation. Often, the learning process results in a changed reasoning and thus argumentative leaps (inconsistencies) that show up in the final text. Therefore, always have others read your work before you submit it.

Some things to avoid:

- You do not have to try to impress people by using words most people have never heard of. Many published articles are like this, and they are poor papers on account of it.
- Do not use colloquial speech, slang, or “childish” words or phrases.
- In English, do not use contractions: for example, “don't” must be “do not” and “isn't” must be “is not” etc.

***Verb tense**:*

Research papers reflect work that has been completed, therefore use the past tense throughout your paper (including the Introduction) when referring to the actual work that you did, including statements about your expectations or hypotheses. Use the past tense, as well, when referring to the work of others that you may cite. Use present tense when what you are conveying is a fact that holds true regardless of your current study.

***First vs. Third Person**:*

most journals have moved away from a very strict adherence to the third person construction, and permit limited use of the first person in published papers. Other disciplines, especially the biomedical fields, still prefer the third person construction. Limit your use of first person construction (i.e., “ I (or we) undertook this study ...).: usually it is most acceptable in the Introduction and Discussion sections, and then only to a limited extent. Use first person in the methods sparingly if at all and avoid its use in the results.

***Active Verbs**:*

Use active verbs whenever possible; writing that overly uses passive verbs is deadly to read and almost always results in more words than necessary to say the same thing.

ACTIVE: “the researcher coded the interviews with open coding”

PASSIVE: “the interview transcripts were coded by the researcher with open coding”.

The clarity and effectiveness of your writing will improve dramatically as you increase the use of the active voice.

***Textual references**:*

References to the research findings of others are an integral component of any research paper. The usual practice is to summarize their theories, methodologies or findings in your own words and then cite the source. Any ideas or other information that are not your own must be substantiated by a reference that is cited in the text. As a rule, in research papers, direct quotation and footnoting are not over-practiced – simply restate the author's ideas or findings in your own words and provide a citation.

***Successful paragraphs, sentences and words***

- A paragraph is consistent if only one idea is being addressed in it. Are yours?
- Every paragraph starts with a sentence summarizing its content. Is this first sentence understandable and brief?
- Make sure that each paragraph has only one thought. You can often split a paragraph after 2/3. If there are two thoughts formulate two paragraphs.
- Do not start two paragraphs with the same word
- Language variance makes texts more dynamic. Therefore, mix short and long sentences. Use short sentences if something important follows as this increases the tension.
- Avoid sentences with sub-clauses.
- Avoid commas if you can use period.
- Avoid auxillary words.
- Avoid repetition of the same or similar terms.
- Avoid fill words that do not affect the content.
- Avoid technical jargon of the discipline.
- Avoid unwanted spaces: Find "Double Space"> Replace "Simple Space"

## 3. WRITING AND NUMBERS

Whether to enter numerals or words for a number is often confusing. In different situations, this will vary, but according to APA7 (the most common style format) under or equal to ten units is a word, 11 and above is numbers. You cannot begin a sentence with a numeral. The number “1,256,781” must be entered at the beginning of a sentence as “One million, two hundred fifty-six thousand, seven hundred and eighty-one”, as ridiculous as it seems. If the number involves a unit of measure, the unit must be likewise spelled out as a word in most cases (pH would be one exception). Work the sentence so you don't have to begin it with the number! When not speaking of data or experimental groupings, use words instead of numerals for small numbers: “two centuries ago”, “For well over fifty years”.., “Of the many millions of fish released”...

## 4. PLAGIARISM

Plagiarism is not to be tolerated and can be easily avoided by adequately referencing any and all information you use from other sources. This includes the use of Generative Artificial Intelligence. In the strictest sense, plagiarism is representation of the work of others as being your work. Paraphrasing other's words too closely may be construed as plagiarism in some circumstances. In journal style papers there is virtually no circumstance in which the findings of someone else cannot be expressed in your own words with a proper citation of the source. If you are unclear about what constitutes plagiarism, please confer with your supervisor.

**Your text is your responsibility**. Do not hide behind others by quoting, citing, paraphrasing and using passive voice. We all know that there is an abundance of AI tools available that can help you during the process of developing your manuscript. In case you adopt AI tools to enhance your learning experience, be sure to do it in a responsible way every time: evaluate the initial output, verify using reliable sources, edit prompts based on that, revise the results to your specific needs and be aware that you are responsible for everything you create with AI.

Your manuscript must consist exclusively of the author's original work. Once again, **your text is your responsibility,** and this includes the entire content (supplementary materials and appendices too). In cases where the work copies, cites, builds on or uses research or data provided by others, the text should acknowledge and reference this in accordance with recognized reference styles. **Inadequate referencing is considered plagiarism**.

Plagiarism is defined as including data or texts written by other persons in one's study, without acknowledging the source. Said differently, plagiarism is the misrepresentation of someone else's original thought as your own. **Such academic misconduct and can lead to dismissal from research institutions, article rejections or retractions from journals, and decreased credibility as a researcher.**

Plagiarism includes:

- copying and pasting any text from any source text without quotation marks and references;
- including a translation of such source texts as mentioned above without quotation marks and references;
- paraphrasing such source texts as mentioned above without due referencing.
- copying others' visual, audio or test material without due reference and thus allowing it to be regarded as one's own work;
- submitting one's own written work twice (e.g. copied from work in a previous paper).

If one of the authors of a joint assignment commits plagiarism, the other authors will be accessory to plagiarism if they should or could have known that the former committed plagiarism. Although we often think of plagiarism as intentional, it can also be accidental. Carelessness while writing, heavy reliance on few sources, the cultural belief that

"imitation is the sincerest form of flattery," and a lack of understanding of what plagiarism is may all lead to inadvertent intellectual theft. The two most widely recognized forms of plagiarism are as follows:

- **Verbatim plagiarism**: Copying text word-for-word from someone else's work. If content from several sources is duplicated, this form of plagiarism is known as mosaic or patchwork.
- **Plagiarism of ideas**: Mentioning someone else's unique idea, whether in the form of a theory, an interpretation, data, a method, an opinion, or new terminology, without citing the source, even if the idea is explained in your own words.

Moreover, there are several less commonly understood but equally concerning forms of plagiarism that should be avoided:

- **Loose paraphrasing**: Paraphrasing someone else's work with only slight changes, effectively maintaining the other author's logic while mentioning most or all of the same ideas. Note that the flow of an argument is indeed an original idea.
- **Plagiarism from alternate sources:** Failing to cite the source of publicly available knowledge that is not in scholarly literature. Similar to journal articles, sources such as books, webpages, blogs, lectures, and personal communication (including descriptions of unpublished ideas, with permission) should be referenced if they contributed unique information to your manuscript.
- **Self-plagiarism and duplicate publication**: Recycling your own previously published text on a small scale (such as reusing a paragraph from one manuscript in the methods section of a second manuscript) or on a larger scale (such as the publication of the same manuscript in two separate journals), respectively. This is perhaps the most often overlooked category of plagiarism in professional academia. Although self-plagiarism and duplication do not entail the theft of another's original ideas, this practice is deemed unethical.

 We recommend following these steps:

**Step 1**: While preparing to write by reviewing the literature, keep careful records of your sources. Citation software, such as Zotero and EndNote, can be very helpful at this stage.

**Step 2**: While writing, try not to directly refer to your sources to avoid inadvertent copying, use multiple sources to ensure a diversity of content, and err on the side of citation.

**Step 3:** After writing, review your manuscript and reference list to ensure that all of the appropriate source citations were included. Additionally, consider checking your manuscript for inadvertent plagiarism using Turnitin, iThenticate, eTBLAST, or other detection tools.

In general, do not copy paste text from sources into your notes without clearly demarcating them as quotes (Grift et al., 2024, pp. 29–32).

# Writing Up Research

Before starting to write the paper, take the time to think about and develop a list of points to be made in the paper. As you progress, use whichever strategy works for you to begin to order and to organize those points and ideas into sections.

## SECTIONS OF A PAPER

This is a checklist of what your proposal should contain:

**Title page** [TO SUBMIT SEPARATELY FROM MANUSCRIPT]

- Title of the manuscript
- Name, surname, affiliation and contacts of author(s)
- Abstract
- keywords

**Manuscript**

a) Repeat title page, but blind

**b) Introduction**

- Make clear what the paper is about in the first sentence
- What exactly is the problem and why is it relevant (to whom?)
- What do we already know about the problem from the academic literature? (short literature review outline)
- Derive and motivate the research question (and if needed sub-questions) – **max 1 question and 1 sub-question per paper**
- Explain what contribution your research will make
- Announce and motivate the structure of the rest of the paper

**c) Literature review / Theoretical Framework /Conceptual framework**

- Explain the proposed theory/ies
- Define the main theoretical concepts based on the available literature and explain their relevance
- Explain relevant concepts in detail; provide bird's eye view of past relevant research

- If applicable formulate hypotheses, propositions, or conceptual model; include detailed arguments for these (avoid throwing randomly formulated hypotheses!)
- Expect you need to cover at least 20 sources (mostly academic papers) to be able to cover the items above.

**d) Methodology and Empirical Strategy**

Describe and motivate:

- Operationalization (how will you measure your concepts)
- methods of data collection (desktop research, interviews, observation, questionnaire, secondary data) and the kind of data you will collect
- Sampling strategy
- Proposed methods of data analysis (e.g. regression analysis, economic modelling, pattern matching, coding and identify relations, grounded theory, interview analysis, focus group analysis, etc …)

**e) Results / Findings**

- objectively present your key results, without interpretation, in an orderly and logical sequence using both text and illustrative materials

**f) Discussion**

- position your results in the extant academic literature to carve out the contribution of your manuscript/study.
- discuss the validity and reliability of findings and arguments;

**g) Conclusions and implications**

- formulate an answer to the main research question(s);
- summarize the main argument and its theoretical and practical relevance;
- reflect on the implications of your research for practitioners i.e. non-academics
- nuance the implications and recommendations if appropriate.
- recommendations to other academic researchers about logical next steps, and provide suggestions for future research

**h) Limitations and future directions**

- acknowledge weaknesses of your study

i) **References**

j) **Appendixes and supplementary material**

# 1. TITLE

In the Title you can only make the simplest statement about the content of your article. Be smart and use catchy keywords that people will find easily.

## 1.1 ABSTRACT AND KEYWORDS

The Abstract allows you to elaborate more on each major aspect of the paper. The length of your Abstract should be kept to about **200-300 words maximum** (a typical standard length for journals), usually in a **single paragraph**. Limit your statements concerning each segment of the paper (i.e. purpose, methods, results, etc.) to one or two sentences, if possible. The Abstract helps readers decide whether they want to read the rest of the paper, or it may be the only part they can obtain via electronic literature searches or in published abstracts. Therefore, enough key information (e.g., summary results, observations, trends, etc.) must be included to make the Abstract useful to someone who may to reference your work.

*How do you know when you have enough information in your Abstract?* A simple **rule-of-thumb** is to imagine that you are another researcher doing an study similar to the one you are reporting. If your Abstract was the only part of the paper you could access, would you be happy with the information presented there?

Although it is the first section of your paper, the Abstract **should be written last** since it will summarize the paper. To begin composing your Abstract, take whole sentences or key phrases from each section and put them in a sequence which summarizes the paper. Then set about revising or adding words to make it all cohesive and clear. As you become more proficient you will most likely compose the Abstract from scratch.

| Do's | Don'ts |
|---|---|
| State the problem at stake | Include lengthy background information. |
| State the question(s) you investigated | Include references to other literature. |
| State the purpose of the study | Use elliptical (i.e., ending with "...") or incomplete sentences. |
| State the methods used (clearly express the basic design of the study) | Include abbreviations or terms that may be confusing to readers. |
| State the major findings<br>• report those results which answer the questions you were asking<br>• identify trends, relative change or differences, etc. | Include any sort of illustration, figure, or table, or references to them. |
| Clearly state the implications of the answers your results gave you. | |

**Check your work:** Once you have the completed abstract, check to make sure that the information in the abstract completely agrees with what is written in the paper. Confirm that all the information appearing the abstract actually appears in the body of the paper.

***Style***:

The Abstract is ONLY text. Avoid acronyms at all costs. Use the active voice when possible, but it may require passive constructions. Write your Abstract using concise, but complete, sentences, and get to the point quickly. Use past tense.

## 2. INTRODUCTION

The function of the Introduction is to establish the context of the work being reported. This is accomplished by discussing the relevant primary research literature (with citations) and summarizing our current understanding of the problem you are investigating. State the purpose of the work in the form of the hypothesis, question, or problem you investigated; and, briefly explain your rationale and approach and, whenever possible, the possible outcomes your study can reveal. Quite literally, the Introduction must answer the questions, "What was I studying? Why was it an important question? What did we know about it before I did this study? How will this study advance our knowledge?"

**Style**: Use the active voice as much as possible. Some use of first person is okay, but do not overdo it.

Begin your Introduction by clearly identifying the subject area of interest. Do this by using key words from your Title in the first few sentences of the Introduction to get it focused directly on topic at the appropriate level. This ensures that you get to the primary subject matter quickly without losing focus, or discussing information that is too general.

**To sum up:**

- Make clear what the paper is about in the first sentence
- What exactly is the problem and why is it relevant (to whom?)
- What do we already know about the problem from the academic literature? (short outline of literature review)
- Derive and motivate the research question (and if needed sub-questions)
- Explain what contribution your research will make
- Announce AND motivate the structure of the rest of the paper

Useful questions:

• *What is the manuscript about?* Title and first paragraph, first sentence should answer this question.

• *Why is that relevant to the reader?* First one or two paragraphs. You must motivate the reader to read on.

• *What do we (academics) already know about this?* Brief and critical outline of literature review/ scientific knowledge of one or two paragraphs. Discuss only the most relevant and use passive citing to describe on what we have consensus.

• *What should we want to know? (Research Question)* Identify a one gap in the extant academic knowledge/practice.

• *How can we break up, research and answer that question in a logical way?* Break up the big research question into the ways you used to answer it. Address them in a logical sequence that you motivate.

• *How would knowing that be relevant to the reader?* Zoom in on the most relevant implications.

• *What is (therefore) the structure of what follows?* Outline the sections of the manuscript.

# 3. REVIEW OF THE LITERATURE/ THEORETICAL BACKGROUND

Keeping in mind the research question, and key concepts embodied, you should provide a critical review of relevant theories and empirical research from available literature in books and journals. Typically, the relevant literature will be substantial. Do an in-depth, balanced review of the primary research literature relevant to your study questions prior to designing and carrying out the experiments. This review will help you learn what is known about the topic you are investigating and may let you avoid unnecessarily repeating work done by others. This literature will form the basis of your Introduction and Discussion.

Citing references represent the link between one's own thoughts and those already published by other authors. **You cite, you do not quote**. Cite active if possible "*Sanders (2019) recommends talking constructively*", as opposed to: "*It is recommended that you talk constructively* (Sanders, 2019)". Cite active if you want to represent or summarize somebody else's evidence or arguments: "*Author (year) claims/shows/assumes that innovation creates growth*". Cite passive if multiple authors support the same argument (in the same way). "*Several authors have shown that innovation creates growth (Author 1, year; Author2, year*)". Cite passive if an author offers supporting evidence to a point you want to make: *"innovation creates growth (author, year)*".

Your literature review should encompass:

- *Possibilities and limitations of existing literature*
- *Why and how did different schools of thought and reasoning differ?*
- *What is irrespective of the differences the broad consensus?*
- *What is your central argument and how does it relate to the literature?*
- *What is the difference to the existing arguments?*

When these questions are answered, you can move on and propose your own contribution to the debate. This will typically consist of a general theoretical framework in which you explain what relationships you expect based on your reading of the literature and analysis of the problem, followed by an empirical strategy [NEXT SECTION] in which you describe the data you collected and the method you propose to analyze that data.

## 3.1 STRUCTURE

The structure of the theoretical section can be thought of as an inverted triangle – the broadest part at the top representing the most general information and focusing down to the specific problem you studied. Organize the information to present the more general aspects of the topic early in the Introduction, then narrow toward the more specific topical information that provides context, finally arriving at your statement of purpose and rationale. A good way to get on track is to sketch out the theoretical section backwards. Start with the specific purpose and then decide what is the

scientific context in which you are asking the question(s) your study addresses. Once the scientific context is decided, then you'll have a good sense of what level and type of general information with which the Introduction should begin.

**Rule of thumb:** introduce each and every concept the reader needs in order to contextualize and comprehend your research as follows:

- Concept 1: definition (reference(s)). How it has been studied in the past. What have been the major understandings. Which are the unresolved issues (that your research picks upon). Why is it a relevant concept, today, for an author to study and a reader to read. What role does it play in your research.
- Concept 2….x: definition (reference(s)). How it has been studied in the past. What have been the major understandings. Which are the unresolved issues (that your research picks upon). Why is it a relevant concept, today, for an author to study and a reader to read. What role does it play in your research.

**Chain** your concepts and paragraphs without logic gaps. How does Concept 2 relate to Concept 1? Has that relation been studied before? Is there a reason why it hasn't (and you want to fill that gap)? Why is this connection relevant today for an author to study and a reader to read? What role does the puzzle of concepts play in your research?

 Verbatim reproduction of other people's work is often less relevant for scientific work. What others actually wrote, can be looked up! Instead it is important you show that you have an overview of the literature and can position your own work carefully in the body of relevant and existing literature. The purpose is to give others due credit for their work and give your reader a good sense of what you build on and where you are heading. You therefore need to scan, collect and briefly describe the relevant literature for your paper yourself. There is no minimum or maximum number of references and articles. That depends on your topic.

 When writing up the literature review you might find yourself anywhere between two extremes:

- The field is already paved ... Where is my gap? Have previous authors overlooked something, do I bring another important factor into play, can I generalize existing arguments/hypotheses to other contexts etc.? Example: "A lot is known about teacher decision making in lesson planning (see for example X and Y 19XX; A et al., 20XX; and B, 20XX). Surprisingly, little is known about how teachers reason during classroom activities, under pressure and time constraints".
- There is nothing/not much out there. Can I translate an existing approach, use data or apply a suitable method from another area and find good arguments for that? Example: There are many case studies on the impacts of burnout on

teacher practices (for example REFS). A lack of good local data on institutional buffers, however, has hitherto prevented academics from studying the policy-side of the phenomenon (REF)".

### 3.2 How do I know which literature to include?

What literature should you look for in your review of what we know about the problem? Focus your efforts on the primary research journals – the journals that publish original research articles. Although you may read some general background references (encyclopedias, textbooks, manuals, etc). to get yourself acquainted with the subject area, do not cite these, because they contain information that is considered fundamental or "common" knowledge within the discipline. Cite, instead, articles that reported specific results relevant to your study.

Learn, as soon as possible, how to find the primary literature (research journals) and review articles rather than depending on reference books. Review articles are particularly useful because they summarize all the research done on a narrow subject area over a brief period of time (a year to a few years in most cases). A range of sources can be used, some of which are high quality, and others are supportive material. Specifically:

- Peer reviewed journals and academic publishers. Take them seriously but discuss them critically. In a good paper, the bulk of references fits this category (80% or more).
- Reputed institutions and governments (e.g. OECD, UNESCO etc.). Use them to illustrate policy interest and for data that give your study "real world" relevance.
- News media agencies (prefer international ones). Use them sparingly and only for illustration. May signal social interest and give your study "real world" relevance.
- Internet and social media. Use sparingly and only for illustration. Do not take the information seriously unless it can be verified with sources of higher quality.

Your main sources of information should be academic, peer-reviewed journals. Prioritize publications within the last 5y with a few and motivated exceptions. Some academics will judge the quality of your work first by the literature you position your paper in. If you choose to join a low-quality debate, why should high quality researchers waste their time on your paper? So, position your work in high-quality, high-impact literature. Google Scholar and many other online search engines will already sort your hits on "relevance" (see above), often measured by the number of citations a paper has received. This measure is not the alpha and omega and you will need to scroll down not to miss relevant (for example more recent) articles. But it is clear you will want to discuss the highly cited papers that are close to the topic you research. Also, keep an eye on specific 'systematic literature review' papers that may have summarized existing literature on a topic closely related to yours; you could add 'systematic literature review' in your search term for example. You can check the

reputation of journals on rankings like www.scimago.com. For working papers, the reputation of the publishing institutions is a good yardstick.

### 3.3 WHAT DO I LOOK FOR IN/REPORT OF THE LITERATURE I CHOSE?

Consider what you need to argue your study. Do you need validation/are you connecting with the X literature piece for their theories/research questions/participants or setting/ methods?

What is the main argument/result in the paper you chose? This can be usually found in the abstract, the introduction (first or last paragraph) or the conclusion (first paragraph). Is it worth going into details? Only if you want to follow the theory, the method or the argument very closely. Usually no more than 3-5 papers per manuscript are reported in detail; for the other papers you can typically do a 'quick scan' & quick report of the main take away of the paper. Write that down in your own words!

**Verbatim quotes** without a source represent plagiarism. Quote verbatim (copy-paste) as little as possible, otherwise different styles need to be combined which disturbs the 'flow' of your argument. If you quote verbatim, do so in italics, making the quote stand out – **when above 40 words**. In verbatim quotes, always add a page number. Treat a quote like a picture, graph, hypothesis or table. Something that illustrates the running text. It never replaces the running text! There is one exception. If you report on an interview study, verbatim quotes are your data and you will use them a lot. In direct quotes, put omissions in parentheses (...) and own insertions in square brackets […].

Here is the information that should flow in your theoretical section:

- Establish the context by providing a brief and balanced review of the pertinent published literature that is available on the subject. The key is to summarize (for the reader) what we knew about the specific problem before you did your experiments or studies. This is accomplished with a general review of the primary research literature (with citations). The judgment of what is general or specific is difficult at first, but with practice and reading of the scientific literature you will develop e firmer sense of your audience.
- Lead the reader to your statement of purpose/question by focusing your literature review from the more general context (the big picture) to the more specific topic of interest to you.

Be sure to **clearly state the purpose and /or problem that you investigated**. When you are first learning to write in this format it is okay, and actually preferable, to use a pat statement like, "The purpose of this study was to."... or "We investigated three possible mechanisms to explain the ... (1) blah, blah..(2)" etc. It is most usual to place the statement

of purpose near the end of the theoretical section, often as the topic sentence of the final paragraph. It is not necessary (or even desirable) to use the words “hypothesis” or “question”, since these are usually implicit if you clearly state your purpose and expectations.

**To sum up:**

- Explain the proposed theory/ies
- Define the main theoretical concepts based on the available literature and explain their relevance
- Explain relevant concepts in detail; provide bird’s eye view of past relevant research
- If applicable formulate hypotheses, propositions, or conceptual model; include detailed arguments for these (avoid throwing randomly formulated hypotheses to paper!)
- Expect you need to cover at least 20 sources (mostly academic papers; start reading early on in period 3 and check with your supervisor if you have an appropriate initial list of relevant sources) to be able to cover the items above.

| Do’s | Don’ts |
|---|---|
| The relevant literature is completely included | Connection between own theory and existing literature is unclear |
| The irrelevant literature is completely ignored | Not the topic, but the argument is decisive for the literature selection |
| The literature is evaluated fairly | Limitation of the literature against the background of the analysis |
| Space is created for one's own argument | It is not about reproducing all published works in the field. Only those papers that illustrate the gap! |
| Do not just report, argue! | |

### 3.4 CONCEPTUAL/THEORETICAL FRAMEWORK

Theorizing can be challenging. Usually, you will not have to come up with novel and full-blown theoretical/conceptual framework for your study. Most likely, you will find, select and apply a framework that fits the problem you chose to research. There usually is one per paper.

Should you want to use a novel one (e.g. by combining existing ones), focus on what you expect to be the most important causal relationships that explain the phenomenon you study. Then look for papers that have studied individual links in that causal chain and see what theoretical frameworks they propose (in their theory sections). It is usually the older, better published articles in the reference lists of papers in your literature review that give you a good idea of what theoretical and conceptual work is commonly used in the area you are doing research in.

- A **conceptual model** outlines the relations between concepts, to create a system of understanding. **It is mostly used in qualitative studies.**
- A **theoretical framework** outlines the relationships in a system of variables. **It is mostly used in quantitative studies.** For example, X influences Y (if applicable, Z). The theory then offers an answer to two questions: Why does this apply? When does this apply? Either probabilistic context (X increases the probability of Y) or deterministic relationship (if X occurs then Y always follows).

Your conceptual model/theoretical framework will typically include all theoretical concepts relevant to your research question. If you are able to verbalize it, you might as well do the reader the service of visualizing it in a diagram. The advantage of verbalization is that you can be explicit about the logic and relate it to the literature. The advantage of visualization is that you can summarize and convey a lot of information in a very efficient manner. The combination of the two gives the reader a complete and precise picture.

*Unsure about what a conceptual/theoretical framework even is?* Check out this publication (among many):

Tondeur, J., Petko, D., Christensen, R., Drossel, K., Starkey, L., Knezek, G., & Schmidt-Crawford, D. A. (2021). Quality criteria for conceptual technology integration models in education: Bridging research and practice. *Educational Technology Research and Development*, *69*(4), 2187–2208. https://doi.org/10.1007/s11423-020-09911-0

# 4. THE CURRENT STUDY

Once we understand the mechanisms behind a (relevant) phenomenon, we have the information we need to explore the situation, change the outcome or understand further. **Provide a clear statement of the rationale for your approach to the problem studied**. This will usually follow your statement of purpose in the last paragraph of the theoretical section. Why did you choose this kind of methodology or experimental design? What are the scientific merits of this particular method? What advantages does it confer in answering the particular question(s) you are posing? **Present a strong argument and rationale to why your study is relevant** (with references whenever possible), **why now, why this way, why you**. Justify each and every step of your decisional process.

Do not discuss here the actual techniques or protocols used in your study (this will be done in the Methods); your readers will be quite familiar with the usual techniques and approaches used in your field. If you are using a novel (new, revolutionary, never used before) technique or methodology, the merits of the new technique/method versus the previously used methods should be presented in the theoretical section.

All that is left after formulating your theory is to convince the reader that this theory indeed explains the facts and is useful in the given context. In academic research we do so by putting theories to the test. For that we need to derive (testable) hypotheses/questions. **State clearly your research question(s).** Prioritize having 1 question per paper. Max 1 sub-question. Why? Because you will not have the space to address everything fully otherwise and you will end up not being clear.

Present the **aim of your study and the aim of the paper** (they might not be one and the same). If this paper is "part of a bigger study" (as it often happens), thread carefully: your reviewer/reader will likely not have access to the "bigger study" when reading this specific paper and needs to have every information to understand the current paper. On the other hand, you don't want to spend a paragraph describing a study that will not be covered by this paper. Economy is your deity.

## 4.1 PARTICIPANTS AND CONTEXT

[This can be addressed before or after Design and methodology]

**Describe the context of the study.** Present your **sampling strategy** and ground it in the literature. As always, justify each and every step of your decisional process. The sampling strategy must be coherent with the research question and study aims. The description of participants must include demographic and other characteristics pertinent to the study aims. Include the date(s) of the study (e.g., 10-15 April 2024) and the exact location of the study area – without hindering participant anonymity.

## 5. DESIGN AND METHODOLOGY

In this section you explain clearly how you carried out your study. Its subsections are usually:

- The sampling strategy [see 1.5.1]
- The organism(s) studied (human, systems, etc). and their pre-study characteristics, and when and where the study was carried out (location and time are important factors). [see 1.5.1]
- The research design
    - the protocol for collecting data, i.e., how the experimental procedures were carried out, and,
    - how the data were analyzed (qualitiative analyses and/or statistical procedures used).

***Style***

The style in this section should read as if you were verbally describing the conduct of the study. You may use the active voice, although this section requires more use of third person & passive constructions than others. Avoid use of the first person in this section. Remember to use the past tense throughout – the work being reported is done, and was performed in the past, not the future.

Organize your presentation so your reader will understand the logical flow of the research steps. Subheadings work well for this purpose. Each step should be presented as a unit, even if it was broken up over time. The experimental design and procedure are sometimes most efficiently presented as an integrated unit, because otherwise it would be difficult to split them up. In general, provide enough quantitative detail (how much, how long, when, etc). about your research such that other scientists could reproduce your design. You should also indicate the statistical procedures used to analyze your results, including the probability level at which you determined significance (usually at 0.05 probability).

 **Replicability** of the study is the most important criterion for the quality of scientific research. Research that is faulty but replicable is more scientific than impeccable research than no-one can replicate. Because one can build on the former, not on the latter. Replicability distinguishes scientific texts from written expressions of opinion. Simplifications and generalizations of observed eveidence (inferences) must be motivated and understandable! Other scientists must come to very similar results when confronted with the same raw data and sources and using the methods you propose. An exact description of your methodology ensures this.

### 5.1 PRESENT THE DESIGN OF YOUR STUDY

How you investigate the research question. Describe the methodology, methods, approaches and instruments you used, ground them in literature and justify your choices. Be sure to include the questions/hypotheses you tested, controls, treatments, variables measured, how many replicates you had, what you actually measured, what form the data take, etc. When using a method described in another published source, you can save time and words by providing the relevant citation to the source. Always make sure to describe any modifications you have made of a standard or published method.

**Choosing your methodology** depends on a number of factors which should be considered when approaching the master study topic:

- Feasibility in the given period and given budget (primary data collection usually takes a lot of time and sometimes money)
- Theoretical implications for the selected method: A test that does not discriminate between competing theories or does not accurately represent the theoretically claimed causalities is meaningless. The chosen method should be a real test. Do not resort to a weak test just to confirm your hypothesis. If you choose a second-best solution, then this must be justified. If the robustness or generalizability is limited, this must be pointed out.
- Sometimes ethical considerations may play a role. Especially when collecting primary data (privacy issues) and working with vulnerable groups.

### 5.2 INSTRUMENTS TO COLLECT DATA

When describing instruments for data collection, it is useful to state where they come from, how they got to the form they are now (e.g. adapted, translated), give examples of their dimensions/areas/items/questions (preferably in a table). Do not insert the whole instrument in the text. If you feel the need to share the instrument, do so in the appendix. Describe when, how and by whom the instruments were adopted to collect data.

Describe the **data collection strategies** for your study in sufficient detail that other scientists could repeat your work to verify your findings. Foremost in your description should be the "quantitative" aspects of your study – the what, how and when of the investigated concepts/variables, so that another scientist needs in order to duplicate your design.

Regarding documentation and replicability, you should adhere to certain transparency criteria:

How were the *observations* selected (respondents, cases, survey period)? Selection criteria?

*Interviews*: Who guided them? And how was a possible influence of the interviewer on the respondents excluded?

Order of questions? Duration of the survey?

Content Analysis: Which queries were performed?

*For existing records*: Reference? Why this data? How reliable are the creators of the data set? How common is the use?

Which statistics program and procedure/code?

How was missing information handled?

Explain clearly **how you have handled the data**:

- For **quantitative** data from **secondary sources** provide the original data plus the datafile or other code that takes you from the raw to the used data. Try to code in a way that others can read your code and quickly reproduce what you have done. Use comments.
- For **survey data** provide a description of sampling and non-response, and create or obtain the codebook for the data. A codebook describes what variables the survey dataset contains, what values a variable can take and what these values mean.
- For **interview data** describe the sampling (who did you invite, who responded), provide interview guides, transcripts and your coding scheme.
- For **experimental data**, describe sampling, provide subject instructions and experimental code files as well as a clear description of treatments and control and randomization procedures.
- For **other types** of data, make sure the reader can reconstruct how the data was collected and what it contains. Replicability is the aim. Describe your data in such a way that others can, in principle, replicate what you have done.

Then present descriptive statistics for your data and discuss them. Tell the reader what you want them to see in the tables and figures you present and draw conclusions. You do not want the reader to do that.

### 5.3 DESCRIBE HOW THE DATA WERE SUMMARIZED AND ANALYZED.

Here you will indicate what types of data summaries and analyses were employed to answer each of the questions or hypotheses tested. Describe the analyses carried out on the data collected. **Do not describe the findings**.

Present descriptive statistics for your data and discuss them. Tell the reader what you want them to see in the tables and figures you present and draw conclusions. You do not want the reader to do that.

The information should include:

- how the data were summarized (Means, percent, etc.) and how you are reporting measures of variability (SD,SEM, etc.). This lets you avoid having to repeatedly indicate you are using mean ± SD.
- data transformation (e.g., to normalize or equalize variances, to group codes into categories).
- statistical tests used with reference to the particular questions they address, and any other techniques used to analyze the data.

| Issue → | The Methods section is prone to being wordy or overly detailed. | The methods section is unclear or non-transparent. |
|---|---|---|
| Problematic example | *The study participants, consisting of 120 students, were each given a pre-test that was administered individually in a quiet room. The pre-test consisted of 20 multiple-choice questions, which were read aloud by the examiner. After completing the pre-test, students were divided into three groups based on their scores. The first group received direct instruction, the second group received inquiry-based instruction, and the third group served as the control group with no additional intervention. The post-test, identical to the pre-test, was administered two weeks later in the same conditions as the pre-test.* | *Students were tested before and after instruction using a standardized assessment. They were divided into different groups, and different methods were applied accordingly. The results were then compared to analyze the effectiveness of the intervention.* |
| Why it does not work | This is a very long and wordy description of a common, simple procedure. It is characterized by single actions per sentence and lots of unnecessary details. | This description lacks key details about the intervention and how students were divided into groups. The vague terms ("different groups," "different methods") make it unclear what was actually done, forcing the reader to guess. |
| Improved example | *A total of 120 students completed a 20-item multiple-choice pre-test before being stratified into three groups based on performance: direct instruction (DI), inquiry-based learning (IBL), and a control group. The post-test, identical to the pre-test, was administered two weeks later under the same conditions.* | *Participants were assigned to direct instruction (DI), inquiry-based learning (IBL), or a control group based on pre-test scores. Each group received its respective instructional method over four weeks. Learning outcomes were assessed using a standardized pre-test/post-test design.* |
| Why it works | Same actions, but all the important information is given in a single, concise sentence. Note that superfluous detail and otherwise obvious information has been deleted while important missing information was added. | Specific terminology replaces vague descriptors, making it clear what was measured and how. By specifying the instructional methods and timeframe, the passage becomes much clearer. |
| Takeaway | Avoid repeatedly using a single sentence to relate a single action; this results in very lengthy, wordy passages. A related sequence of actions can be combined into one sentence to improve clarity and readability. | Avoid using ambiguous terms to identify study parameters. Use clear and specific identifiers that make the passage understandable in and out of context. |

**To sum up:** Describe AND motivate:

- Proposed methods of data collection (desktop research, interviews, observation, questionnaire, secondary data) and the kind of data you collected
- Sampling strategy
- Operationalization (how you measured the concepts)
- Methods of data analysis (e.g. regression analysis, modelling, pattern matching, coding and identify relations, grounded theory, interview analysis, focus group analysis, etc. …)

## 6. RESULTS (EMPIRICAL STUDIES)

Question to ask yourself

• Did I avoid confirmation bias?

• Do I want to confirm my hypothesis at all costs, or do I try to prove the theory in the most efficient and precise way possible?

• Are the sources of the data, the choice of control variables, the operationalization of the variables, the selection of cases and the choice of method sufficiently justified?

• Did I check the generalizability of the results?

The function of the Results section is to objectively **present your key results, without interpretation**, in an orderly and logical sequence using both text and illustrative materials (Tables and Figures). The results section always begins with text, reporting the key results and referring to your figures and tables as you proceed. Summaries of the statistical analyses may appear either in the text (usually parenthetically) or in the relevant Tables or Figures (in the legend or as footnotes to the Table or Figure).

Present the results of your experiment(s) in a sequence that will logically answer the question stated in the previous sections. The body of the Results section is a text-based presentation of the key findings which includes references to each of the Tables and Figures. The text should guide the reader through your results stressing the key results which provide the answers to the question(s) investigated. A major function of the text is to provide clarifying information. You must refer to each Table and/or Figure individually and in sequence (see numbering sequence) and clearly indicate for the reader the key results that each conveys. Key results depend on your questions, they might include obvious trends, important differences, similarities, correlations, maximums, minimums, etc. Prepare the Tables and Figures as soon as all the data are analyzed and arrange them in the sequence that best presents your findings in a logical way. A good strategy is to note, in a draft of each Table or Figure, the one or two key results you want to address in the text portion of the Results.

***Structure***

Once you have done your analyses and decided how best to present each one, think about how you will arrange them. Your analyses should tell a "story" which leads the reader through the steps needed to logically answer the question(s) you posed since your Introduction. The order in which you present your results can be as important in convincing your readers as what you actually say in the text.

Any Table or Figure you present must be sufficiently clear, well-labeled, and described by its legend to be understood by your intended audience without reading the results section, i.e., it must be able to stand alone and be interpretable. Overly complicated Figures or Tables may be difficult to understand in or out of context, so strive for simplicity whenever possible. If you are unsure whether your tables or figures meet these criteria, give them to a fellow author and ask them to interpret your results.

 The purpose is NOT to show all that you have done, but rather that you have a good sense to separate main- from marginal results and are able to focus on the former.

 If results are not what you expect, double check your method, code and argumentation. If they are what you expect, triple check your method, code and argumentation. Of course, errors should always be remedied if found, even if that means you lose (significant) results. Always present and interpret your results as they are, not as you would like them to be. Even if you find a non-result, this is an important contribution to the literature (despite that it is hard to publish). Whether positive or negative, you need to make sure the result you report is really there and not due to badly collected data, an inappropriate analysis or mistakes or errors.

 A good results section reports results on the derived hypotheses, predictions and implications that concluded the theoretical framework section by applying the methods on the data described in the empirical strategy section. No surprises there. If you have done the earlier sections well, the reader is already convinced your research question is relevant, the theoretical framework applicable and the empirical approach is suitable to test its applicability to the question at hand. Your reader is ready to be convinced. All you need to do is present the results.

 **Report negative results** – they are important! If you did not get the anticipated results, it may mean your hypothesis was incorrect and needs to be reformulated, or perhaps you have stumbled onto something unexpected that warrants further study. Moreover, the absence of an effect may be very telling in many situations. In any case, your results may be of importance to others even though they did not support your hypothesis. Do not fall into the trap of thinking that results contrary to what you expected are necessarily “bad data”. If you carried out the work well, they are simply your results and need interpretation. Many important discoveries can be traced to “bad data”.

***Style***

Write the text of the Results section concisely and objectively. The passive voice will likely dominate here but use the active voice as much as possible. Use the past tense. Avoid repetitive paragraph structures. Again, keep it simple. Present only the main results. Limit yourself to making a few key points only. Think about how you might best visualize your most important results. A good picture is worth a thousand words and can convey a message much more powerfully than a table.

Simple rules to follow related to Tables and Figures:

- Tables and Figures are assigned numbers separately and in the sequence that you will refer to them from the text. The first Table you refer to is Table 1, the next Table 2 and so forth. Similarly, the first Figure is Figure 1, the next Figure 2, etc.
- Each Table or Figure must include a brief description of the results being presented and other necessary information in a legend.
    - Table legends go above the Table; tables are read from top to bottom.
    - Figure legends go below the figure; figures are usually viewed from bottom to top.
- When referring to a Figure from the text, "Figure" is abbreviated as Fig., for example, Fig. 1. Table is never abbreviated, e.g., Table 1.

 **Do not interpret the data here**. The transition into interpretive language can be a slippery slope. Consider the following examples.

| | **Quantitative Example** | **Qualitative Example** |
|---|---|---|
| **Concise and Objective Reporting** | *"Students who received inquiry-based instruction demonstrated significantly higher post-test scores compared to those in the direct instruction group ($M = 78.4$, $SD = 6.2$ vs. $M = 71.2$, $SD = 7.0$; $t(118) = 3.45$, $p < .01$) (Table 2). The effect size for this difference was moderate (Cohen's $d = 0.54$)".* | *Participating teachers described student engagement as noticeably higher during group-based activities compared to lecture-based instruction. One participant noted, 'Students were more vocal and willing to contribute ideas when working collaboratively.' Similarly, another teacher observed that 'students seemed to retain more information when explaining concepts to peers' (Interview, Participant 3)."* |
| **Why this works** | The focus remains on objectively presenting the numerical results, emphasizing key differences without interpretation. | It objectively presents participant statements without drawing authorial conclusions about effectiveness. |
| **Straying into Interpretation** | *The results suggest that inquiry-based instruction is a more effective teaching method, as evidenced by the significantly higher post-test scores in this group ($M = 78.4$, $SD = 6.2$) compared to the direct instruction group ($M = 71.2$, $SD = 7.0$). The moderate effect size ($d = 0.54$) reinforces the pedagogical superiority of student-centered approaches."* | *The interviews indicate that collaborative learning is a superior instructional strategy for improving engagement and retention. As one teacher explained, 'Students were more vocal and willing to contribute ideas when working collaboratively,' which suggests that social interaction enhances learning outcomes."* |
| **Why this does not work** | Words like "suggest" and "superiority" introduce interpretation rather than merely reporting the data. | The phrase "indicates that collaborative learning is superior" makes an interpretative claim rather than simply reporting what was said. |

**Things to consider as you write your Results section**

What are the "results"? When you pose a testable hypothesis that can be answered experimentally, or ask a question that can be answered by collecting evidence, you accumulate observations about those phenomena. Those observations are then analyzed to yield an answer to the question. In general, the answer is the "key result".

The above statements apply regardless of the complexity of the analysis you employ. So, in an introductory course your analysis may consist of visual inspection of figures and simple calculations of means and standard deviations; in a later course you may be expected to apply and interpret a variety of statistical tests. Your supervisor may tell you the level of analysis that is expected.

For example, suppose you asked the question, *"Is the average height of male students the same as female students in a pool of randomly selected Biology majors?"* You would first collect height data from large random samples of male and female students. You would then calculate the descriptive statistics for those samples (mean, SD, n, range, etc) and plot these numbers. In a course where statistical tests are not employed, you would visually inspect these plots. Suppose you found that male Biology majors are, on average, 12.5 cm taller than female majors; this is the answer to the question.

Notice that the outcome of a statistical analysis is not a key result, but rather an analytical tool that helps us understand what our key result is.

**Some problems to avoid**

Do not reiterate each value from a Figure or Table – only the key result or trends that each conveys. Do not present the same data in both a Table and Figure – this is considered redundant and a waste of space and energy. Decide which format best shows the result and go with it. Do not report raw data values when they can be summarized as means, percents, etc. Avoid devoting whole sentences to report a statistical outcome alone.

## 6.1 QUANTITATIVE RESULTS

Statistical test summaries (test name, p-value) are usually reported parenthetically in conjunction with the results they support. Always report your results with parenthetical reference to the statistical conclusion that supports your finding. This parenthetical reference should include the statistical test used and the level of significance. For example, if you found that the mean height of male Biology majors was significantly larger than that of female Biology majors, you might report this result (in blue) and your statistical conclusion (shown in red) as follows: "Males (180.5 ± 5.1 cm; n=34) averaged 12.5 cm taller than females (168 ± 7.6 cm; n=34) in the 2024 pool of Biology majors (two-sample t-test, $t = 5.78$, 33 d.f., $p < 0.001$)".

If the summary statistics are shown in a figure, the sentence above need not report them specifically but must include a reference to the figure where they may be seen: "Males averaged 12.5 cm taller than females in the 2024 pool of Biology majors (two-sample t-test, t = 5.78, 33 d.f., p < 0.001; Fig. 1)".

 **Beware**: In quantitative studies, the use of the word *significant* implies that a statistical test was employed to make a decision about the data; for example, the test indicated a larger difference in mean heights than you would expect to get by chance alone. Limit the use of the word "significant" to this purpose only. If your parenthetical statistical information includes a p-value that is significant, it is unnecessary (and redundant) to use the word "significant" in the body of the sentence.

### 6.2 Qualitative findings

In qualitative research, results are typically reported with direct quotes from participants as supporting evidence, alongside references to themes or patterns that emerged from the data. **Always present your findings objectively, avoiding interpretation or discussion**. When referencing participant responses, include relevant identifiers (e.g., participant number, role) to maintain clarity. For example, if a study found that teachers perceived student-led discussions as more effective than traditional lectures, the results might be reported as follows:

> *"Teachers consistently described student-led discussions as fostering deeper engagement. One participant noted, 'Students were more likely to explore ideas critically when leading discussions rather than passively listening' (Teacher 4).* Similarly, another teacher observed, *"During student-led sessions, I saw students making connections between topics that they usually struggled with in lectures" (Teacher 7).* This pattern was evident across multiple participants, highlighting a shared perception of the benefits of student autonomy in learning (Table 2)."
>
> If themes are represented visually, reference the figure or table summarizing the findings:
>
> *"Teachers highlighted student-led discussions as promoting critical thinking and engagement (Fig. 2). One participant remarked, 'Students engaged more when they had control over the conversation' (Teacher 3)."*

Although qualitative research primarily focuses on rich, descriptive data, some statistical analyses can be incorporated to enhance the rigor of findings. Descriptive statistics, such as frequency counts, percentages, and measures of central tendency, are often used to summarize participant demographics or the distribution of themes. Additionally, some qualitative studies apply inferential statistics, such as Cohen's kappa for inter-rater reliability or chi-square tests for

categorical comparisons, to support methodological transparency. For example, if a study examined teachers' perceptions of student engagement across different instructional strategies, the results section might report:

> *"Analysis of interview transcripts revealed that 78% (n = 25) of teachers preferred student-led discussions over lectures for promoting engagement. This trend was consistent across experience levels, with early-career teachers (n = 12) and veteran teachers (n = 13) expressing similar views (Fig. 1). Inter-rater reliability for thematic coding was high (Cohen's κ = 0.82), indicating strong agreement among coders."*

If inferential statistics are used, they should be presented with appropriate reference to their significance:

> *"Thematic analysis identified three dominant perceptions of classroom engagement: student autonomy, active discussion, and relevance to real-world applications. The distribution of these themes did not significantly differ between primary and secondary educators ($\chi^2(2, N = 40) = 2.13$, $p = .35$), suggesting similar engagement priorities across grade levels."*

**For quantitative studies:**

Force yourself to be critical, think of real, sensible robustness tests and torture your data. Easy ways to criticize a lot of empirical work (also published work) are to ask:

Have you really identified a causal relationship or is this mere correlation?

If you take your data to really literally mean what they measure, is the result still interesting and more than trivial?

Are data representative?

What alternative explanations than the one you proposed are consistent with or might explain your findings?

**For qualitative studies:**

Critically think about other explanations for relationships you see. Good questions to ask yourself:

How do my case(s) and interviews contribute to answering my research question?

Can results be generalized or are they case specific?

What alternative explanations than the one you propose are consistent with or might explain your findings?

# 7. DISCUSSION AND CONCLUSIONS

*[This section can also be split into two: Discussion | Conclusions. Occasionally, it can be split into three: Discussion | Conclusions | Limitations and future directions – according to how much you have to say and how much detail you can provide for all the sections in the paper to be balanced (i.e. do not make a section out of 5-10 lines of text.]*

The function of the Discussion and Conclusions section is to interpret your results in light of what was already known about the subject of the investigation, and to explain our new understanding of the problem after taking your results into consideration. The Discussion and Conclusion section of a paper are not to be underestimated, as these capture your interpretation of (the significance of) your research approach and results for academia and practice. The Discussion will always connect to the Introduction and theoretical sections by way of the question(s) or hypotheses you posed and the literature you cited, but it does not simply repeat or rearrange those sections. Instead, it tells how your study has moved us forward from the place you left us at the end of them.

Useful questions:

Does the content summarize the results of the work in a concise way?

Explanatory power and limitations of the study are presented without excess or understatement?

Is there an outlook on further research?

Have all the brackets that were opened in the introduction been closed?

Is it possible to replicate to a story from the introduction?

Fundamental questions to answer here include:

- Do your results provide answers to your question(s)? If so, how do you interpret your findings?
- Do your findings agree with what others have shown? If not, do they suggest an alternative explanation or perhaps a unforeseen design flaw in your study (or theirs?)
- Given your conclusions, what is our new understanding of the problem you investigated and outlined in the Introduction?
- What would be the next step in your study, e.g., what experiments would you do next?

***Structure***

It usually includes four ingredients: discussion, implications, limitations, conclusion.

First, **position your results in the extant academic literature** to carve out the contribution of your study. Limit this discussion to a few key publications already discussed in the introduction. In the discussion you should consistently refer back to your theory and empirical findings, in order to relate your empirical outcomes to already existing insights.

Organize the section to address each of the studies for which you presented results; discuss each in the same sequence as presented in the Results, providing your interpretation of what they mean in the larger context of the problem. Do not waste entire sentences restating your results; if you need to remind the reader of the result to be discussed, use "bridge sentences" that relate the result to the interpretation: "*The high learning outcomes of the participants suggest that...[interpretation]"*.

Use **subheadings**, if need be, to help organize your presentation. Be wary of mistaking the reiteration of a result for an interpretation, and make sure that no new results are presented here that rightly belong in the results. You will necessarily make reference to the findings of others in order to support your interpretations. In fact, you must relate your work to the findings of other studies – including previous studies you may have done and those of other investigators. You may find crucial information in someone else's study that helps you interpret your own data, or perhaps you will be able to reinterpret others' findings in light of yours. In either case you should discuss reasons for similarities and differences between yours and others' findings. Consider how the results of other studies may be combined with yours to derive a new or perhaps better substantiated understanding of the problem. Be sure to state the conclusions that can be drawn from your results in light of these considerations. You may also choose to briefly mention further studies you would do to clarify your working hypotheses. Make sure to reference any outside sources as shown in the Introduction/theoretical section.

Then, it is important to reflect on the **implications** of your research for practitioners i.e. non-academics. Why should managers, policy-makers, decision-makers care? What is it that they can take away from your paper?

**Limitations**. No academic study is perfect, and now is the time to acknowledge weaknesses of your study. For example, reflectively critique and identify weaknesses concerning theoretical approach and methodology. Finally, **conclude** telling the reader briefly what can be learned from your manuscript. In the conclusion you should:

- formulate an answer to the main research question(s);
- summarize the main argument and its theoretical and practical relevance;
- discuss the validity and reliability of findings and arguments;
- nuance the implications and recommendations if appropriate.

Do not repeat the result section, summarize and conclude and end your paper with what your research could or should mean for the real world. Also, make **recommendations** to other academic researchers about logical next steps, and provide suggestions for future research.

***Style***

Use the active voice whenever possible in this section. Watch out for wordy phrases; be concise and make your points clearly. Use of the first person is okay, but too much use of the first person may actually distract the reader from the main points.

**Do not introduce new results in the Discussion and Conclusions**. Although you might occasionally include in this section information which helps explain something you are discussing, the narrative must not contain new data (from your study) that should have been presented earlier.

## 8. REFERENCES AND SUPPLEMENTARY MATERIAL

Your **reference list** must be in alphabetical order of last name of first author (or institution). It contains the full information on an article/chapter/working paper and is consistent throughout in a single referencing style. We suggest the guidelines provided by the American Psychological Association (**APA**), but **always check with the journal**. There are ample online sources to help you out. See for example for APA: https://aut.ac.nz.libguides.com/APA7th. Reference management software such as Mendeley, Endnote and Zotero can also be used to ensure consistent referencing.

 Your reference list **must include all references used in your manuscript** (you can exclude references that are specific to appendices and supplementary material provided you provide a separate reference list for those documents) and **does NOT include references that were not used** (or deleted). Check this carefully.

Plan time to check and finalize your reference list. It is important and will be read. A sloppy reference list reflects poorly on your work.

In an **appendix** you can put material that is auxiliary/helpful for the reader to follow and reconstruct what you have done, but that is not essential to follow the main line of argumentation of your paper. A delicate balance needs to be struck. Do not simply dump everything into an appendix. Do not put secondary material in your main text.

A good check is that you should be able to read, follow, understand and be convinced by the study without looking at its appendix. The appendix then holds the material that you mention and refer to in footnotes and table notes in the manuscript to guide the reader where to find further details. In the manuscript you present the main results, in the appendix are the details and in supplementary materials is the rest of the material one would need to reproduce your entire analysis (raw data, code books, coding schemes etc.).

- In **experimental papers** you would put more detailed analyses into the appendix and provide screen shots and coding for the experiment in supplementary material.
- In **survey**-based research you would provide code book and raw data in supplementary material and put details of for example cluster analyses into the appendix.
- In **interview**-based studies you would put tables with interviewees, the interview guide and coding scheme into the appendix and the recordings and full, coded transcripts into supplementary material [**unlikely**]

 It is a bit of an art to decide what goes in the main text, the appendix and the supplementary material. There is the tendency to put too much detail in the main text and dump supplementary material into the appendix, treating that as an overflow. Going over this carefully and critically towards the end can really improve the readability of the paper.

# It is not ready yet!

## 1. SELF-REVISE YOUR PAPER + PEER REVIEW

After drafting your first version of the manuscript, put it aside for a few days. Most authors revise their papers at least 2-3x before giving it out for peer review. Go back over your paper now and read it carefully; read it aloud. Does it say what you wanted it to say? Do any ideas, steps, or interpretations need to be moved around within the text to enhance the logical flow of your arguments? Can you shorten long sentences to clarify them? Can you change passive verbs to active forms? Do the Tables and Figures have sufficient information to stand alone outside the context of the paper? Use your dictionary to correct spelling and your spell checker to catch typos.

Other useful questions:

*Are the reasoning chains still conclusive?*

*Are all paragraphs well linked?*

*Are there any redundancies and gaps?*

*Is the main argument, and/or chain of arguments, sufficiently clear and understandable*?

**Have knowledgeable colleagues critique your paper**. Use their comments to revise your paper yet again.

***Structure (checklist)***

- Does the rough structure of the manuscript fit?
- Are individual paragraphs interconnected?
- If transitions are missing mark it the text and rework them
- Eliminate unnecessary passages (put in the footnotes first and then rework them)
- Do the chapters have an introduction and a conclusion?
- Are there meaningful subheadings in the sections
- Are sections and subsections roughly of similar size
- Do I conclude and connect paragraphs, subsections and sections?
- Is the flow of the text logical and obvious?
- Strategic redundancies to keep the focus on the ‘red thread’: These are sub-step to the overall argument
- Are the contents of the individual chapters functionally different?

## 2. PREPARE THE FINAL DRAFT

Carefully proof-read your final draft to make sure its as well done as possible. Double check that you have properly cited all your sources in the text and in the References. Check the formatting one last time.

Anonymize your paper for double blind review. Eliminate every instance of yours and other authors' names in the text and references. Anonymize the context if necessary. You can substitute them with "Author1", "Author2…" or "XXX". When you think you are done, think again and check. Then go in File >inspect document> check for markings and anonymize fully. Consider that **journals will not hesitate to desk reject your paper if it does not comply with formatting requirements.**

# Almost Everything You Wanted to Know About Making Tables and Figures

Once your analyses are complete, you will need to summarize the data and results for presentation to your readers. Data summaries may take one of four forms: text, Images, Tables and Figures.

***Text***

Contrary to what you may have heard, not all analyses or results warrant a Table or Figure. Some simple results are best stated in a single sentence, with data summarized parenthetically: *"Students in the collaborative learning group scored higher on the post-test ($M = 82.3$, $SD = 5.6$) compared to those in the traditional lecture group ($M = 74.8$, $SD = 6.2$; $t(58) = 3.21$, $p < .01$)."*

***Images***

Images visually represent conceptual frameworks, models, theories, or abstract ideas. They help illustrate relationships between concepts, provide an overview of theoretical perspectives, or depict instructional strategies. Unlike Figures, which primarily display empirical data, Images serve to clarify complex ideas through visual representation. For example, a diagram showing Vygotsky's Zone of Proximal Development (ZPD) in relation to teacher scaffolding would be classified as an Image, as it visually communicates an educational theory rather than a specific dataset.

***Tables***

Tables present lists of numbers or text in columns, each column having a title or label. Do not use a table when you wish to show a trend or a pattern of relationship between sets of values – these are better presented in a Figure. For instance, if you needed to present population sizes and sex ratios for your study and you planned to focus on the differences among groups according to (e.g.). educational routines, you would use a table. However, if you wanted to show us that sex ratio was related to population size, you would use a Figure.

***Figures***

Figures are visual presentations of results, including graphs, diagrams, photos, drawings, schematics, maps, etc. Graphs are the most common type of figure and will be discussed in detail; examples of other types of figures are included at the end of this section. Graphs show trends or patterns of relationship.

***Descriptive Legends or Captions***

A clear and complete legend (sometimes called a caption) is essential. Like the title of the paper itself, each legend should convey as much information as possible about what the Table or Figure tells the reader: what results are being shown in the graph(s) including the summary statistics shown; the subjects studied in the study (if applicable).

Provide specific explanatory information needed to interpret the results shown (in tables, this is frequently done as footnotes). When you are starting out, you can use an appropriate example from a published paper as a model to follow in constructing your own legends. Where do you place the legend? Below the Table or Figure.

# 1. HOW TO REFER TO VISUALS IN THE TEXT

Every Image, Figure and Table included in the paper MUST be referred to in the text. Use sentences that draw the reader's attention to the relationship or trend you wish to highlight, referring to the appropriate Image, Figure or Table only parenthetically:

**Highlighting a Key Trend:**

"*Enrollment trends indicate a steady increase in female participation in STEM courses over the past decade, with the most significant growth occurring between 2015 and 2020 (Fig. 2). In contrast, male enrollment remained relatively stable during this period, resulting in a narrowing gender gap*." This sentence highlights the trend rather than merely pointing to the figure.

**Emphasizing Comparative Data:**

*"Students in the flipped classroom model demonstrated higher engagement levels, with 85% participating actively in discussions, compared to 62% in traditional lecture settings (Table 3). This difference suggests that student-centered approaches may encourage more classroom interaction."* The key comparison is highlighted, making the data meaningful.

 Avoid sentences that give no information other than directing the reader to the Image, Figure or Table: "*Table 1 shows the summary results for male and female enrolments at Bates College*". This is the title of the figure, no more no less.

 Abbreviation of the word "Figure": When referring to a Figure in the text, the word "Figure" is abbreviated as "Fig"., while "Table" and "Image" are not abbreviated. All words are spelled out completely in descriptive legends.

## 1.1 HOW TO NUMBER IMAGES, TABLES AND FIGURES

Images, Figures and Tables are numbered independently, in the sequence in which you refer to them in the text, starting with Image 1, Figure 1 and Table 1. If, in revision, you change the presentation sequence of the figures and tables, you must renumber them to reflect the new sequence.

### 1.2 Placement of Images, Figures and Tables within the Paper

In consideration of your readers, place each Image, Table or Figure as near as possible to the place where you first refer to it (e.g., the next page). The Images, Figures and Tables may be embedded in the text, but avoid breaking up the text into small blocks; it is better to have whole pages of text with Figures and Tables on their own pages.

## 2. The Anatomy of an Image

An image in academic writing is more than just a visual aid; it is a structured representation of a concept, theory, or framework designed to enhance understanding. A well-constructed image includes a clear title that conveys its purpose, labeled components that guide interpretation, and a logical arrangement that reflects the relationships between ideas. Whether illustrating a pedagogical model, a cognitive process, or an educational framework, an image should be both visually intuitive and conceptually precise, ensuring that it complements the text rather than merely decorating it.


Image 1.

The Interactive Constructive Active Passive (ICAP) framework – Chi & Wylie, 2014.

## 3. THE ANATOMY OF A TABLE

Table 1 below shows the typical layout of a table in three sections demarcated by lines. Tables are most easily constructed using your word processor's table function or a spread sheet such as Excel. Gridlines or boxes, commonly invoked by word processors, are helpful for setting cell and column alignments, but should be eliminated from the printed version. Tables formatted with cell boundaries showing are unlikely to be permitted in a journal.

Example 1: Courtesy of Shelley Ball. (Anderson, 2014, p. 31)

Table 4. Population variation in hatch success (mean percent) of unfertilized eggs for females from populations sampled in1997. N = number of females tested. <--Table legend

| Population | mean (%) | Standard deviation | Range | N |
|---|---|---|---|---|
| Beaver Creek [T] | 7.31 | 13.95 | 0-53.16 | 15 |
| Honey Creek [T] | 4.33 | 7.83 | 0-25.47 | 11 |
| Rock Bridge Gans Creek [T] | 5.66 | 13.93 | 0-77.86 | 38 |
| Cedar Creek [P] | 6.56 | 9.64 | 0-46.52 | 64 |
| Grindstone Creek [P] | 8.56 | 14.77 | 0-57.32 | 19 |
| Jacks Fork River [P] | 5.28 | 8.28 | 0-30.96 | 28 |
| Meramec River [P] | 5.49 | 10.25 | 0-45.76 | 45 |
| Little Dixie Lake [L] | 7.96 | 14.54 | 0-67.66 | 71 |
| Little Prairie Lake [L] | 6.86 | 7.84 | 0-32.40 | 36 |
| Rocky Forks Lake [L] | 3.31 | 4.12 | 0-16.14 | 43 |
| Winegar Lake [L] | 10.73 | 17.58 | 0-41.64 | 5 |
| Whetstone Lake [L] | 7.36 | 12.93 | 0-63.38 | 57 |

<--Column titles

<--Table body (data)

[T] = temporary stream, [P] = permanent streams, [L] = lakes. <--footnotes

<--Lines demarcating the different parts of the table

In the example, notice:

- the presence of a period after “Table #”;
- the legend (sometimes called the caption) goes above the Table;
- units are specified in column headings wherever appropriate;
- lines of demarcation are used to set legend, headers, data, and footnotes apart from one another.
- footnotes are used to clarify points in the table, or to convey repetitive information about entries;
- footnotes may also be used to denote statistical differences among groups.

## 4. THE ANATOMY OF A FIGURE

The sections below show when and how to use the most common Figure types (bar graph and frequency histogram).

Below are example figures (typical line and bar graphs) with the various component parts labeled in red. Refer back to these examples if you encounter an unfamiliar term as you read the following sections (Anderson, 2014, p. 33).

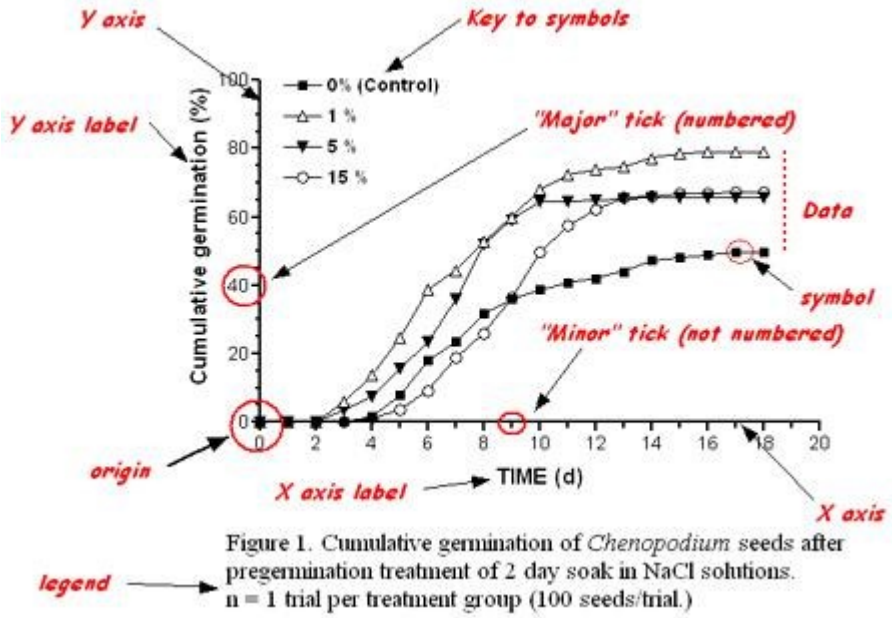


Figure 1. Cumulative germination of *Chenopodium* seeds after pregermination treatment of 2 day soak in NaCl solutions. n = 1 trial per treatment group (100 seeds/trial.)

Some general considerations about Figures:

- Big or little? A good rule of thumb is to size your figures to fill no more than one-half of a page. Readers should not have to reach for a magnifying glass to make out the details, but you need space for your text to explain the relevant information close to the figure itself. Compound figures may require a full page.
- Color or no color? Most often black and white is preferred. Journals will charge more for colour. Every aspect of your Figure should convey information; never use color simply because it is pretty.
- Title or no title? Always use a title for Figures included in a paper.
- Tick marks – Use common sense when deciding on major (numbered) versus minor ticks. Major ticks should be used to reasonably break up the range of values plotted into integer values. Within the major intervals, it is usually necessary to add minor interval ticks that further subdivide the scale into logical units (i.e., a interval that is a factor of the major tick interval). For example, when using major tick intervals of 10, minor tick intervals of 1,2, or 5 might be used, but not 4.

### 4.1 COMPOUND FIGURES

When you have multiple graphs, or graphs and others illustrative materials that are interrelated, it may be most efficient to present them as a compound figure. Compound figures combine multiple graphs into one common figure and share a common legend. Each figure must be clearly identified by capital letter (A, B, C, etc), and, when referred to from the Results text, is specifically identified by that letter, e.g., "...(Fig. 1b)". The legend of the compound figure must also identify each graph and the data it presents by letter.

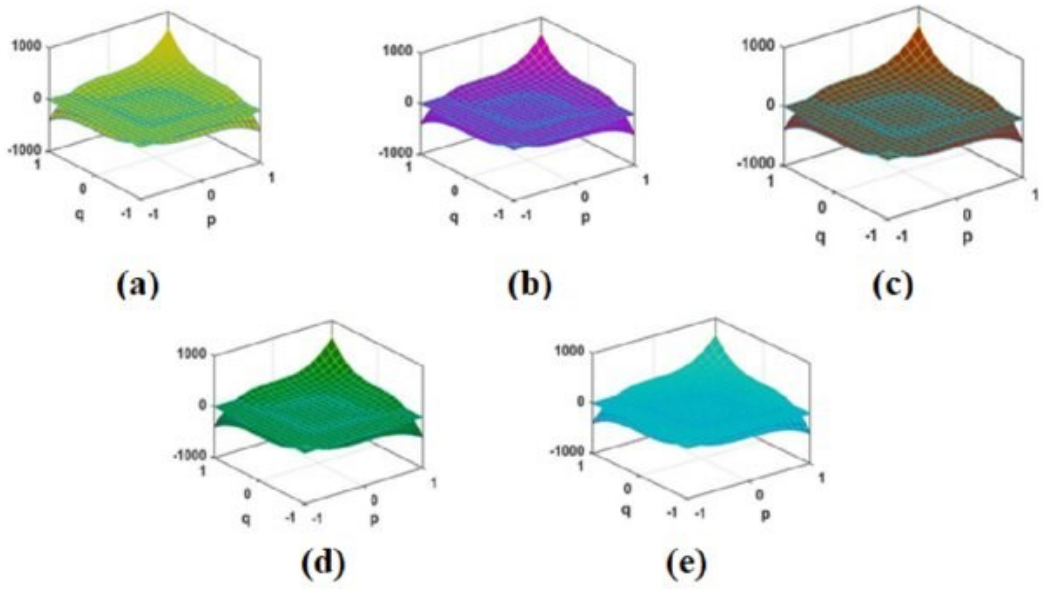


Figure #. The graphical representations of Theorems 3.5–3.7 with p and q. Khabyah, A.A. (2023). Mathematical aspects and topological properties of two chemical networks. *AIMS Mathematics*, *8*(2), 4666-4681. doi: 10.3934/math.2023230, p.8.

### 4.2 COMMON FIGURE TYPES

#### *4.2.1 Bar Graph*

Bar graphs are used when you wish to compare the value of a single variable (usually a summary value such as a mean) among several groups. For example, a bar graph is appropriate to show the mean sizes of plants harvested from plots that received 4 different fertilizer treatments. (Note that although a bar graph might be used to show differences between only 2 groups, especially for pedagogical purposes, journals would prefer that you save space by presenting such information in the text).

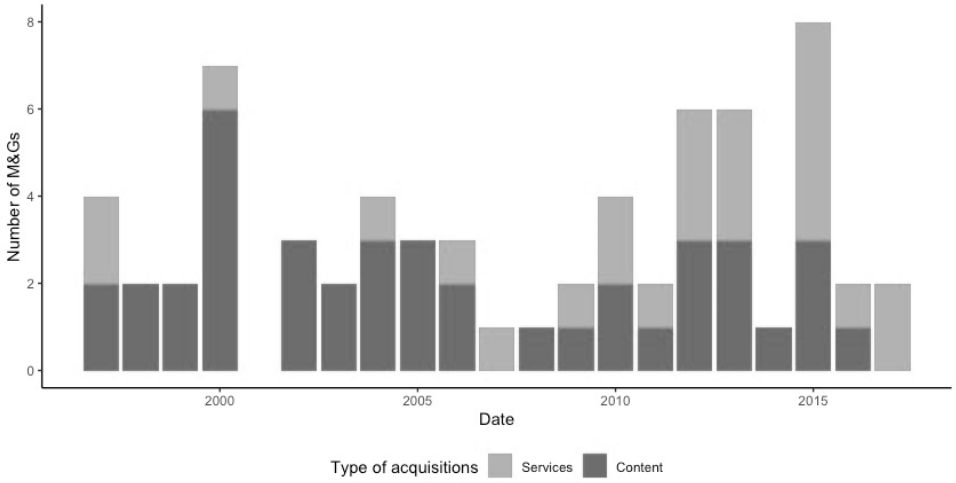


Figure #.

Diversification of Merging & Acquisition of Elsevier from academic contents to data services. Source: https://commons.wikimedia.org/wiki/File:Diversification_elsevier.jpg

In this example notice that:

- the caption goes below the figure.
- A period follows “Figure #” and the caption itself.
- “Figure” is not abbreviated.
- The measured variable is labeled on the Y axis.
- The categorical variable is labeled on the X axis, and each category is designated.
- A second categorical variable within type of acquisitions has been designated by different bar fill color. The bar color must be defined in a key, located wherever there is a convenient space within the graph.

### *4.2.2 Frequency Histogram*

Frequency histograms (also called frequency distributions) are bar-type graphs that show how the measured individuals are distributed along an axis of the measured variable. Frequency (the Y axis) can be absolute (i.e. number of counts) or relative (i.e. percent or proportion of the sample). A familiar example would be a histogram of exam scores, showing the number of students who achieved each possible score. Frequency histograms are important in describing populations, e.g. size and age distributions.

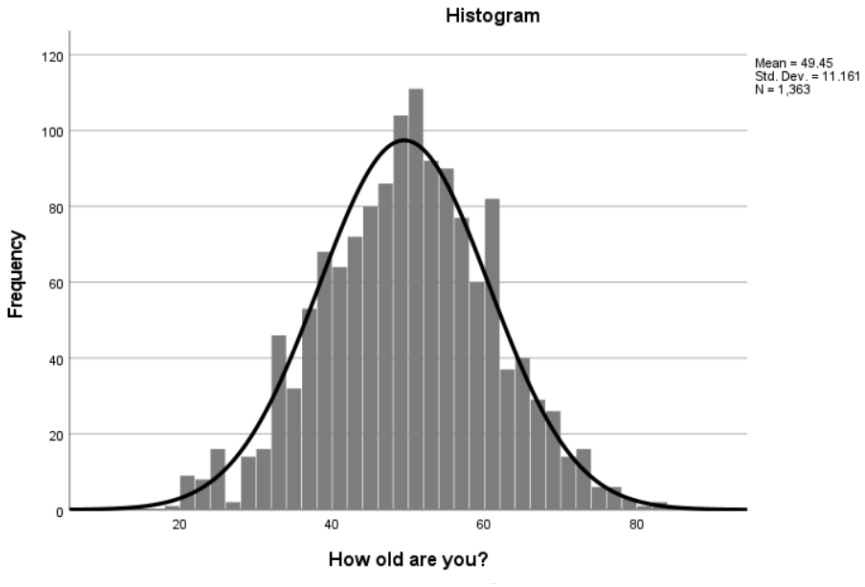


Figure #.

Normality of age. Source: https://commons.wikimedia.org/wiki/File:Diversification_elsevier.jpg

Notice several things about this example:

- The Y axis includes indication that relative frequencies are used. Better would be to have also "%" in parentheses.
- The measured variable (X axis) has been divided into categories ("bins") of appropriate width to visualize the population distribution.
- Sample size is clearly indicated, either in the legend or (in this case) the graph itself.
- The Y axis includes numbered ticks to allow easy determination of bar values.

# Appendix

## WORD USAGE IN SCIENTIFIC WRITING

Adapted by Ottavia Trevisan – from Leslie Carraway. (1999). *Mammalian Species*.

http://www.bates.edu/biology/student-resources/resources/

Listed herein are words, terms, and expressions commonly misused or used in ways that sometimes produce ambiguous statements. Included are explanations of usage advocated by editors of many scientific journals. The objective of scientific writing should be to report research findings, and to summarize and synthesize the findings of others, with clarity and precision. Thus, colloquialisms, jargon, contrived acronyms, and "faddish" terminology and expressions should be avoided. Editors recognize that authors are ultimately responsible for all aspects of their publications including grammar, word usage, and clarity and precision of construction. Therefore, this list is intended as a guide, not as dogma.

ABOVE – *(... the above method; ... as mentioned above*). A term often used in reference to something preceding, but not necessarily "above"; a loose reference, convenient for writers, but not for readers. Also, remember, if something was mentioned previously, to do so again is redundant.

ACCURATE – *(...an accurate estimate...*). "Accurate" implies complete freedom from error or absolute exactness. An "estimate" is an approximation. Try "...a reliable estimate"

AFFECT; EFFECT – Affect is a verb that means to influence. Effect, as a verb, means to bring about – as a noun, it means result.

ALL OF; BOTH OF – just "all" or "both", will suffice in most instances.

ALTERNATE; ALTERNATIVE- Alternate implies first one then another; alternative implies a choice among two or more incompatible objects, situations, or courses of action.

AMONG – Use when comparing more than two items.

AND, HENCE; AND, THEREFORE; AND, THUS – (*The educational access was reduced and, thus, the population worsened*) Both a conjunction and conjunctive adverb unnecessary. Use one or the other.

AND/OR – Use one or the other, not both. Write what is actually meant.

APPARENTLY; APPARENT - Means obviously, clearly, plainly, evidently, seemingly, ostensibly, or observably. You may know which meaning that you intend, but your reader may not. Consider obvious(ly), clear(ly), seeming(ly), evident(ly), observable", or "observably" to improve clarity.

AS – A conjunction used in reference to a comparison: always associated with a verb, e.g., "Pocket mice carry seeds in their cheeks as [NOT like] do kangaroo rats". Do not use in place of the words "that" or "whether". Compare with "like".

AS WELL AS - Use “and”; it means the same.

ASSUME – An active verb often used with an inanimate subject to produce a ludicrous statement (*The hypothesis “assumes” that .... or The model “assumes”*). Models or hypotheses cannot assume anything! However, to use a model or to test a hypothesis certain assumptions often are required: the person who uses the model or tests the hypothesis must make the assumptions.

AT THE PRESENT TIME; AT THIS POINT IN TIME – Use “currently” or “now”; they mean the same.

BELOW – See comments about “above”, Directions do not change ambiguity.

BETWEEN – Use when comparing only two items.

BY MEANS OF – Just “by” will suffice in most instances.

CARRIED OUT – ( *... studies were “carried out” at* ..). This is a colloquial usage, try “conducted”, “performed” or “..... was studied”.

CASE – Can be ambiguous, misleading, or ludicrous because of different connotations. (*In the “case” scotch whiskey...*) Often used in padded sentences. If absolutely necessary, use “..instance”; for example, “in this instance”.

COLLECTIVE NOUNS – Take singular verbs when the group is regarded as a unit, but plural verbs when the individuals of the group are regarded separately. Research is a collective noun with singular verb. So is information.

COMMAS AND PUNCTUATION – Not precisely matter of word usage except in relation to how words are put together. The trend is toward less punctuation (particularly fewer commas), but such requires careful writing without misplaced or dangling elements. Use a final comma in series before “and” and “or”.

COMPARE WITH; COMPARE TO – To “compare with” means to examine differences and similarities; to “compare to” means to represent as similar. Usually, one “compares with” and “contrasts to”.

COMPRISE – Before common misuse, “comprise” meant to contain or include, but not to constitute or to compose. The distinction seems useful and worth preserving. Therefore. “the whole comprises the parts, but the parts do not comprise the whole”.

DATA – A plural noun that agrees with a plural verb or pronoun. “These data.”... “'Data were.... “ Not “this data” or “data was”. Commonly used with an active verb to produce ludicrous image; for example, “The data show.... “ Data may be interpreted by an investigator or the investigator may draw inferences from data. Often the word can be omitted without altering the meaning. Also, data don't have size, so avoid “too little data” to describe inadequate samples; try “too few data”.

DECREASED – Do not use in place of “lesser”. Decreased means to “diminish” (as in size, amount, or strength). Lesser is used primarily as an adjective when making a comparison.

DIFFER FROM; DIFFER WITH – One thing “differs from” another, although you may “'differ with” your colleagues in discussions.

DIFFERENT FROM; DIFFERENT THAN – “Different from” always!

DONE – *Research was done in the spring*. Could mean either completed or conducted. Use either as appropriate, but be precise.

DUE TO – Due is an adjective often mistakenly used as a preposition. “Due to” implies causality when only a relationship may be intended. Try “related to” or, if causality is intended, use “because of”.

DURING THE COURSE OF; IN THE COURSE Of – Just “during” or “in” will suffice.

EITHER…OR; NEITHER...NOR – Apply to no more than two Items or categories.

EQUALLY AS GOOD; EQUALLY AS GOOD AS-Just “equally good” will do.

ETC. - Avoid entirely!!

FELT - (*It was “felt” that..).* One feels cloth, but “believes” ideas.

FORMER; LATTER – These words refer only to the first and second of only two items or categories.

GIVEN – *(“At a given time…”)* “.'Fixed”, “specified” or “specific” are more precise. “Given” has several meanings.

HIGH(ER); LOW(ER) -Overused! Commonly used imprecisely or ambiguously for “greater”. “less(er)”, “larger”. “smaller”, “more”. or “'fewer”. Sometimes gobbledygook is produced such as, “*Occurrences of higher concentrations were lower at higher levels of effluent outflow*”. Guess what that means?!

HYPHENATED COMPOUND MODIFIERS – Hyphenation often is necessary to indicate which adjective or nown modifier is modifying which noun. “A small-grain analysis.”... (a fine analysis, not an analysis of small things).

IMPORTANT – Something simply can't be “important” without reason, and usually it is that *reason* that is of interest to the reader. (*Dandelions are an “important” item in the diet of some animals*: Are dandelions “important” because those animals eat more of them? Are they “important” because different animals eat them? Are they “important” because they provide some nutritional requirement for that animal that is not available in other plants? Try “More rabbits ate dandelions than any other food item”.

IN FACT; AS A MATTER OF FACT – Usage tends to weaken preceding and subsequent statements by implying that they might be less than factual. If a lead word is essential try “indeed”

IN ORDER TO - “To” will suffice; the remainder is padding.

IN VIEW OF THE FACT THAT - Overly wordy. try “'because”.

INTERESTING; INTERESTING TO NOTE – Presumptious! Let the reader decide what is interesting. What is interesting to you may not be to the reader.

IRREGARDLESS - No such word! Use “regardless” or “irrespective”

IT SHOULD BE MENTIONED (NOTED, POINTED OUT, EMPHASIZED) – Such phrases add nothing but words. Get to the point, omit the padding.

IT WAS FOUND (DETERMINED, DECIDED) – Could be evasive: write frankly and directly. Instead of: "It was found' that some participants have more than 2 children” write “some participants have more than 2 children”.

LESS(ER); FEW(ER) – “Less” refers to quantity; “few” refers to number. *“He drank less beer today, so there were fewer empty cans”.*

LIKE – A preposition, always associated with an object (nouns, pronouns, or noun phrases). Used correctly when it replaces the phrases “similar to” or “similarly to”. E.g., Grasshopper mice howl like [NOT as] coyotes. Compare with “as”.

MAJORITY; VAST MAJORTIY – “Majority” means more than half. “Vast” suggests immensity of extent. In almost all instances “most” will be more precise.

MEASUREMENTS – Measurements are recorded: they are never “taken” or “made”. Dimensions or characters are measured. See taken.

NON – a prefix, usually not hyphenated. Avoid overuse. Don't use “non” to substitute for established negative prefixes or where “not …” will serve. Use “incorrect” or “not correct”, never “noncorrect”. Similarly, use “unreliable” or “not reliable”, and “not significantly different”.

NOT INCORRECT; NOT INCONSISTENT WITH; NOT UNCOMMON Double negatives become incomprehensible. Use “correct”, “consistent with”, or “common” to express positive concepts of correctness, consistency or commonness.

ON AVERAGE – A colloquial usage. Probably unnecessary in science writing. Write “The average length of... was “...

ONCE; WHEN – Avoid use of “once” to mean when, as “once” can mean one time, formerly, simultaneously, or immediately. *When (not “once”) the child located the game, he began to play*”

OUT; IN – (... 14 “out” of 17.)., (…14 “in” 17..).. or (... to find “out” if…). In most instances, “out” and “in” can be omitted without altering the meaning. Use “... 14 of 17”... and “... to find”... or “... to determine”...

PARTIALLY; PARTLY – “Partially"“ implies bias in favor of one or the other. “Partly” is the more precise term when the concept of proportion or portion is meant.

PERCENT; PERCENTAGE – Use the percent sign (%) with numerials; use percentage in reference to the portion of the whole expressed in hundreds. Compare with proportion.

PREDOMINATE; PREDOMINANT – “Predominate” is a verb, “"predominant” an adjective. The adverb is “predominantly” not “predominately”.

PREVALENCE; INCIDENCE – “Prevalence” means the number per unit of population at a specific time. “Incidence” means the number in a population per unit time. “The reported incidence of measles in kids in Northwest Illinois averaged 23 cases per year”. “The prevalence of measles in children in 1961 was 23 per 1,000 examined”.

PRIOR TO; PREVIOUS TO – “Previous” and “prior” are adjectives that modify nouns. There are “prior” and “previous” events that occur before something else. Likewise, there are “subsequent” events that occur after something else. However, events do not occur “previous to”, “prior to”, or “subsequent to” something else. Use “before”, “preceding” or “after"“ as the situation requires.

PROBLEM- Indicates a question open to inquiry or a proposition stating something to be done. Often misused. *The drug “problem” in pregnancy caused*… The sentence needs to be rewritten. Perhaps a better way to express the meaning would be. “" high drug usage in pregnancies caused”...

PROPORTION – Use in the sense of “part”, e.g. the relation of one part to another or to the whole with respect to magnitude, quantity, or degree. Compare with percent.

PROVEN – “Proven” is an adjective” but “proved” is the past participle. Be careful of this word; rarely is anything “proven” in science. We test hypothesis and sometimes fail to reject one, but this is not proof.

PROVIDED; PROVIDING – “Provided” usually followed by “that” is the conjunction; “providing"“ is the participle.

REASON WHY – Omit “why”. The “reason"“ is the “why”.

RESPECTIVE; RESPECTIVELY – Avoid use if possible.

SAID - Often used incorrectly as “Jones (19'0) said .... “ Nothing was “said” so use “wrote”, “noted”, “suggested”, “reported”, “recorded”, or some other term.

SEE – *(See Smith (1980)).* Superfluous! The reference alone is adequate.

SINCE – "'Since" has a time connotation, from some time in the past to the present. For clarity, do NOT use as a synonym for "because".

SMALL IN SIZE; RECTANGULAR IN SHAPE; GREEN IN COLOR; TENUOUS IN NATURE – All superfluous. Use "small", "rectangular", "green", and "'tenuous" alone.

SWITCHING TENSES – "Wilson (1980) and Genoways (1979) *'have* reported' that grammatical errors *'are'* common in manuscripts that *'were'* submitted for publication". Use the simple past tense – "found", "were", "had", "occurred" - to report the findings of others. Use the present tense for describing organisms/objects/truths. However, do not change tenses within paragraphs. Avoid use of the emphatic mood (When they "*did*" occur...)..

TAKEN – [*Data were "taken" from Smith (1982).]* Smith's data may have been used, but they were not "taken" (extracted) from Smith! Likewise, one does not "take" or "make" measurements; "dimensions", or "features" are measured.

THAT; WHICH – These are two words "that" can help, when needed, to make intended meanings and relationships unmistakable, "which" often is of prime importance in science writing. If the clause can be omitted without leaving the modified noun incomplete, use "which" and enclose the clause with commas or parentheses; otherwise, use "that".

THIS; THESE – These pronouns (among others) commonly are used to begin sentences when the antecedents to which they refer are unclear. (*Elephants, whales, and bats are mammals, although bats fly like birds. "These" animals are endothermic*). It is unclear whether just mammals are endothermic, just the birds, or both the birds and mammals. Make sure that the antecedents of "these" pronouns are clear!

TO BE – Frequently unnecessary. (*The difference was found "'to be" significant*). Omit "found to be". There is no change in meaning.

TO SEE – (More research is needed "'to see" if technology changes brain structure). "To see" means to perceive by the eye. Substitute "to determine", "to ascertain", or "to detect"

TOTAL – (A "'total" of 10 teachers was observed). Commonly superfluous as "Ten teachers were observed" means the same thing. When absolutely necessary to use "A total of" as the subject. Note that it takes a singular verb irrespective of the magnitude of the total to which reference is made.

UTILIZATION; UTILIZE – "Use" will suffice.

VARYING; VARIOUS; DIFFERENT; DIFFERING-Commonly misused as synonyms. "Varying" amounts or "differing" conditions imply individually changing amounts or conditions rather than a selection of various amounts or different conditions.

VERY; QUITE; SOMEWHAT; CONSIDERABLE – Avoid modifiers that impart indefinite measure. For example, "A 'very' large effect" does not provide an indication of how large or provide a scale for judging the relative size of the effect. Either write "a large effect" or better, "A .7 large effect size".

WHERE – Implies a locality, position, or direction. Do not use for "in which" or "for which". (Direct relationships in which (not where) teachers and students..).

WHICH IS; THAT WERE; WHO ARE - Usually superfluous. (*The data "'that were" related to age were analyzed firs*t). Omit "that were"; it doesn't change the meaning. (*The site, "which is" located near Corvallis,...*) Omit "which is."

WHILE -Implies simultaneity. Often misused for "although" or "whereas".