



Introduction

Engaging in scientific writing provides an active approach to students' development of concepts, to structuring knowledge, to shaping their approach to science and to increasing self-awareness in the process of learning itself. It involves familiarity with the kinds of text that are written by members of the scientific community, practice with writing in science lessons and the acquisition of writing skills in general.

Students will engage with the following.

1 Texts written by the scientific community

These include review articles, research papers, abstracts and scientific articles in daily papers. Texts may have specific traditional structure and language, some of them inflexible and predefined.

2 Texts that students write for science lessons

Learning science involves different writing tasks which include explanations of scientific phenomena, reasoned and well-founded answers to questions, summaries, laboratory or field trip reports, and information research reports and reviews. There is a close connection between scientific writing and reading skills. This is true of skills relating both to the structure of the text and to its content.

In order to develop scientific writing, it is important to set many challenging and interesting activities, which involve writing different kinds of texts.

In Post-16 science courses, students are frequently expected to produce extended pieces of writing. Scientific writing is not a skill which is particularly developed at pre-16. Explicit teaching and developing of the skill early on in an advanced level course should support students' work and the time you spend marking!

This skill area looks at:

- how to write in science
- how to write a summary
- how a scientific report is structured
- how to write a scientific review
- how to write an abstract
- how to compile a bibliography
- how to write up a practical as a research paper
- how to write a scientific article.

Intended learning outcomes

Students will be able to:

- understand the key characteristics of scientific writing
- recognise the characteristics and structure of several kinds of text commonly used



Introduction

in the scientific community, such as an abstract / brief summary, research report and research review

- write scientific material for different purposes and audiences
- evaluate and improve their scientific writing.

Recommendations

1 We recommend working with students on scientific writing only after they have completed some of the activities in Skill Area 3, Scientific Writing (especially the activities focusing on in-depth reading and visual representation of texts) and Skill Area 4, data representation.

2 Students need to consider the audience and purpose of the piece of writing they are producing, as this will influence the complexity and vocabulary with which they will write.

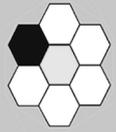
Criteria	Scientific journal	Popular scientific journal
Audience	Scientists within and outside the field of research, students, journalists	People with a general interest
Purpose	To inform and to avoid duplication. This is the most important way in which scientists communicate with one another	To inform and to entertain
Level of writing	Technical terms are used for the target professional audience	Language needs to be tailored to a target audience not familiar with professional terms in the different science fields

A few useful pointers for students on writing in science are listed below:

- language should be precise and clear, avoid needless complexity of language i.e. jargon
- express your ideas in clear sentences, short sentences are generally more comprehensible
- maintain a focus on the objective and purpose of your writing, do not ramble
- each paragraph should start with a clear topic sentence that introduces the general topic that is covered in the paragraph.

3 Work in this Skill Area could benefit from collaboration with the teachers responsible for teaching English.

4 Information and additional education material dealing with writing skills can be found on the following sites:



Introduction

Writing guidelines for engineering and science students

<http://www.writing.eng.vt.edu/index.html>

Common types of writing assignments

<http://www.wisc.edu/writing/Handbook/Assignments.html>

The science of scientific writing

<http://www.amstat.org/publications/jcgs/sci.pdf>

Guide to grammar and writing

<http://webster.commnet.edu/grammar/>

What is good writing?

<http://writingguide.geneseo.edu/?pg=topics/whatisgood.html>

Ten ways to boost your writing

<http://www.collegeboard.com/article/0,3868,2-8-0-27642,00.html>

Principles of composition

<http://webster.commnet.edu/grammar/composition/composition.htm>



Writing a summary

Relates to Activity 5.1 Writing a summary.

What do I need to know?

A summary is a shortened version of the original text. Its purpose is to highlight the main points of the original. An abstract is a brief summary of a scientific paper, lectures given at scientific meetings, or any other situation requiring a brief presentation of scientific activity. The abstract is the 'shop window' of scientific research and activity. It helps the reader to know whether they need to read the whole paper.

What does a good summary look like?

- It has the title of the summary.
- It has no more than 500 words.
- It has a short introduction which explains the importance of the topic.
- It explains how / where you found the information.
- It describes your most important findings.
- It makes a conclusion and recommendations on what you found out.
- It is to the point and clear.

The difficulty with writing a summary is deciding what should be left out. A suggested strategy on how to tackle the task is listed below.

- 1 Read the pieces of text first for understanding.
- 2 Highlight topic sentences and key words.
- 3 Score out less important information.
- 4 Jot down the key ideas from the text.
- 5 Examine the criteria for what a good summary should look like.
- 6 Using the criteria, produce an outline of what your summary will include.

The main aim of this activity is to develop writing skills, not researching skills. It is therefore important to ensure that students do not spend too much time locating the sources of information but focus on the quality of their written summary. Students find it difficult to write summaries, often paraphrasing the whole text. As a class it may be useful to produce a list of success criteria for what a good summary should be.

Modelling the activity could provide further guidance. Students could be given the question and sources. Using highlighter pens, or using electronic text displayed on a whiteboard, key points could be identified in a whole class activity. Students could then produce their summary in pairs (writing partners). As a clearer understanding is developed, students could produce their own summaries, formulate their questions and find their own sources.



Scientific reports and reviews

Relates to Activities 5.4 Recognising a scientific report 5.5 Arranging a scientific report and 5.6 The structure of scientific reviews.

Scientific publications (both in the printed form and online) include two types of scientific articles - reports on various studies or research projects and reviews.

A research paper or 'report' describes a new experiment, conducted by the author(s). It describes the methods, results and conclusions regarding the work and its implications in relation to the wider field.

A review paper is a summary of work which has been published in a number of papers in a particular field of research. Many reviews draw information from papers by a number of different authors.

The two types of article differ in terms of their structure too. A review is generally divided into sub-sections with sub-headings based on the content they present. The sub-headings differ from one article to the next.

Articles that present a report on a study, on the other hand, all follow a uniform structure standardised throughout the scientific community. A research paper includes a title, abstract, introduction, experimental procedures, results and discussion, conclusions and a bibliography.

In general, students find reading a review more difficult than reading a research report. They find it hard to identify the purpose of the article, its logical structure or the central message it seeks to present. By contrast, the standard structure of a report helps understanding by identifying the different sections.

These activities require a substantial amount of reading. There are different ways of reading and in these activities skimming and scanning are required. Skimming involves glancing quickly through a passage to get the gist of it and scanning involves searching for a particular piece of information. If this is not made clear at the start of the activity, students may start to carry out close reading and therefore find it difficult to complete the task.



Writing scientific review articles

Relates to Activity 5.7 Writing a scientific review article.

This is a challenging task and students will require support and clear guidelines.

A good review should include

Structure:

- the article includes introduction, body and conclusions
- the article title is correctly formatted (names of the author, institute and class - Arial 12 point font, aligned)
- there is a clear and logical progression of writing.

Content:

- the article presents content that is relevant to the subject
- the scientific content is correct and accurate
- the introduction provokes interest and encourages the reader to read on
- use has been made of the appropriate articles and relevant information from them.

Language:

- the sentences are concise and clear
- the sentences are written in flowing language
- the sentences are written correctly in terms of language and punctuation.

A stimulus activity using the success criteria would help contextualise understanding of what a good article looks like. Students in groups could be given a short article at an appropriate level and asked to comment on the criteria within the article. Through identifying and discussing the criteria with their peers, a greater understanding of what they are required to write will be developed. This should result in a more successful product.



Writing and reviewing abstracts

Relates to Activities 5.8 What abstract? and 5.9 Writing an abstract.

Writing an abstract is a vital learning tool. When there is a need to hold a class discussion on a particular piece of material, reading an abstract by all participants does not take much time and enables useful discussion.

The abstract must be short, to the point and clear, present the aims of the work, the central ideas and describe in brief the main components of the work, the results and conclusions. It is normally around a half or a full page long.

A good abstract includes:

- the name of the study
- the names of the authors and the institution they are associated with
- a short introduction to the subject of the research and a short account of the importance of the research subject and the motive of the research
- a condensed description of methods, principles and ways of working
- a description of the most important findings of the study
- the conclusions, recommendations and lessons learned
- lack of division into paragraphs or secondary headings.

Getting students to highlight how the abstract answers the following questions could support the discussion.

Why would this paper be of interest to me?

What questions does it address?

What conclusions does it come to?



Evaluating scientific writing

Relates to Activity 5.11 Evaluating scientific writing.

Students will make clearer and more meaningful progress if they have a clear understanding of the intended learning outcomes and are able to identify them in their own work. Peer and self-assessment is much more than students marking their own and one another's work. It is an opportunity for them to reflect on their work, learn from one another and plan how to improve it. This increases students' responsibility for their own progress and promotes independent learning.

In this activity we consider two methods of evaluating work. They are:

Holistic evaluation - giving a grade based on general impression, referring to the components of the essay vaguely or not at all. This gives an overall view of the work and helps validate the detailed evaluation of each component.

Analytic evaluation - giving a weighted grade according to a long list of criteria, under a number of main categories: structure, content, language and form. When summing up the analytic evaluation, it sometimes happens that the total grade comes out much lower than expected. In this case, the analytic evaluation is not sufficient and needs to be supplemented by holistic evaluation.

Examples of these evaluation methods and the combination between them can be found on the Internet, for example:

<http://www.swc.utexas.edu/samples/evaluatingpapers/holistic.shtml>

<http://www.swc.utexas.edu/samples/evaluatingpapers/weighted.shtml>

<http://www.swc.utexas.edu/samples/evaluatingpapers/nonweighted.shtml>

Throughout this Skill Area we have looked at success criteria for different aspects of scientific writing. Students should therefore develop a clear understanding of the evaluation criteria. If students do struggle with this activity you may need to model the process to the class using an anonymous piece of work. After the activity students must be provided with the time to improve their article before submitting it to the teacher.

If the piece of work relates to course work, using the examination assessment criteria would be more relevant than the LSS guidelines.