‘Writing for Specific Academic Purposes with a particular focus on the importance of the practitioner in the writing process.’

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Developing materials for lab report writing in three STEM disciplines

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Important disclaimer!

My scientific career to date:

- Thrown out of Physics class in June 1976 (32%)
- Thrown out of Chemistry the same year (46%)
- Put into bottom O-Level Maths set (1977-8)
- Took Maths O-level in June 1978 (Grade E)
- Took Biology O-level in June 1978 (Grade B)
- Re-took Maths O-Level in November 1978 + extra coaching (Grade E)
- In relationship with a Cambridge statistician (1981-1995)
- Married to an engineer (1995-present)
- Passed "The Science of Archaeology", Level 1, OU, 2009 (10 credits!)

This presentation is therefore, of necessity, a non-scientific view.

Mind the gap (1)

Teaching STEM students on EGAP Pre-sessionals: almost nothing we teach applies to STEM

1) Assignments: types & structures are different
2) Content of materials: when "scientific" topics are chosen by non-STEM EAP teachers, they are always "about science," not actual science
3) Ways of thinking: content & language are different
4) Ways of expressing ideas: especially "argument" – a different way of arguing, via the selection, analysis & presentation of data

Mind the gap (2)

An EAP practitioner who thinks that the main aim of EAP is to teach students what they need to know (rather than what we think we know) might go through these stages when developing materials:

- Teach STEM students. Sense their frustration at not being taught what they need to know. Empathise. Try to share their world.
- Spend nearly 5 years meeting the same Engineering PhD student in one-to-one consultations; watch thesis being written from first draft to binding. Become world's second expert on counts part reliability modelling using surrogate wind turbine data for tidal stream devices. After three years or so, astonish student by remembering where she moved Section 2.2.1 and by remembering the dates of the references.
- Ponder the myriad ways in which scientific thinking and writing differ from social sciences and arts/humanities, and wonder how scientists manage to cope in a comma-free universe.
- Consider what STEM students might need to learn about writing. Concision, referencing, clarity, paragraphing, punctuation, paragraphing, punctuation...(did I mention punctuation?).

Mind the gap (3)

Meanwhile(1): pick up handouts in every lecture theatre. Beg students for writing samples. Beg other ELC teachers to pick up handouts in lecture theatres and collect writing samples from their students too.

Meanwhile (2): take part in STEM faculty induction sessions. Make appointments to meet STEM faculty members. Discover that they are as passionate about writing as you are, and that student inability to paragraph or punctuate makes them cry. Beg for more samples and access to their web pages.

Meanwhile (3): Maximise any random encounters with STEM faculty members at staff training courses, and on the 15A Bus (Consett to Durham), but try not to behave like heat-seeking missile.

Mind the gap (4)

- Next: do some background reading: “Learning to Think” by Janet Gail Donald; “How to Write a Scientific Paper” by George K. Toworfe; devour EAP journal articles on STEM writing.

- Work as much as you can of your reading into your materials, but realise that not much of it actually applies to your institution or your students.

- Look at student samples and try to analyse them in terms of what does apply at your institution.

- Finally: produce materials from your samples and teach them. Get feedback. Reconsider. Repeat this design cycle as necessary (every year, basically).

And here's what the non-STEM EAPpractitioner learns:

Key considerations in STEM writing (1)

1) Selection of material
2) Organisation
3) Clarity

"The key points in this process are careful selection, organisation and emphasising of the most salient data/information, the elimination of non-essentials and clear and concise writing".

Source: "How to Write a Scientific Paper" by George K. Toworfe, Flowers Publications (2009) (p.xi)

Key considerations in STEM writing (2)

Scientific writing is:

- Explanatory rather than argumentative
- The data drives the writing (rather than arguments about, or opinions on, the data)
- Logical content order is key: logic must be maintained from sentence to sentence and from paragraph to paragraph.

Key considerations in STEM writing (3): genre structures at Durham

LAB REPORTS	RESEARCH REPORTS	ESSAYS
Limited by number of pages, not by word count (including page limits for appendices), and get slightly longer each year. No limits in Yr 4 but less is more... Are very heavily scaffolded, especially in Yr 1 (all sciences) Sometimes accompanied by a data interpretation task (Bio) which carries a lot of marks Often preceded by pre-reading tasks (and "Discovery Sessions" in Physics) IMRD structure, though with variations between disciplines of naming of parts (see Slide 14)	Lab reports in all sciences get longer and they become research reports with word rather than page limits. - Appendix page counts are removed (3rd year) As research gets freer, the reports imitate published papers more and more. PhD engineers and mathematicians are encouraged to publish in their second and third years, often as part of a research group IMRD structure with greater flexibility and more sub-sections; the dissertation is essentially a very long lab report	UG Biologists at Durham write essays from the start (and for exams); 2nd year essay exams determine choices of Yr 3 modules UG Psychologists don't write essays until Yr 2 Erasmus UG Biologists are often put into Yr 3 and usually do a lit review + a long research report (3,000 words in each case) UG Mathematicians do a long writing project in Yr 3 UG Physicists don't write essays at all at Durham!

Bio & Physics lab/research report differences at Durham: are they like this at your institution?

Physics	Biology
LaTex is preferred, but Word can be used	Usually uses Word
A lab/research report needs an abstract	Abstract usually not required until 3rd year (for long research report)
Methods section is called “Methods” and <u>must</u> include theory/theories, can be split into subsections	Methods section is called “Materials and Methods”, has less theory, can also have subsections
Appendices are limited to 1 page in Yrs 1 and 2 but are unlimited in Yr 3	Discussion section is called “Conclusion” in UG Yr 1 lab reports and can use “I” (“I believe the best and most accurate method to be ...”): “I” disappears by Yr 3!
Does not use “I”. Can use “we” as lab experiments are conducted in pairs	Published papers almost always use “we” as teams are usually involved

Key considerations (4): Introductions

Lab report introductions do not follow the structure we teach in EGAP: they are often much longer than 10% of the text (can be 20%-30%) and often begin with a one-sentence historical contextualisation.

- Scientific introductions can, however, establish the context of the research in several ways:
    - historical background of research (if relevant)
    - classifications/typologies
    - definitions
- There is not usually a “thesis statement”, but a statement of aims/objectives or focus (“This report aims to...”/”This report focuses on...”/”The focus/aim of this report is...”).
- Markers look for “explanatory power”: the ability to synthesise huge amounts of complex information and present it logically and clearly.
- The introduction is strongly linked to reading (so should be referenced quite heavily compared to the methods section).

Key considerations (5): Discussion sections

- Always carry the bulk of the marks in a lab report/research report so students should spend the most time and space on this.

- The discussion section is strongly related to the reading and to the introduction.

- Students are advised to do the introduction and discussion sections after they've done the methods and results sections, which are much more straightforward.

  - **BUT A LAB REPORT IS NOT A COLLAGE:**

“THE MOST IMPORTANT THING IS TO GUIDE THE READER THROUGH THE THOUGHT PROCESSES”

(Dr Jen Topping, 1st Yr Biology Lab Supervisor, Durham, 2014)

- **So students have to think about flow and throughput too.**

Key considerations (6): Paragraphs

In Europe in 2010, the latest year for which figures are available from the European Society of Human Reproduction and Embryology (ESHRE), the mean pregnancy rate per embryo transfer was 35.5% after IVF and 32.1% after ICSI.[3] Compared to the rates from 1997, the first year for which figures were available from the ESHRE, of 26.1% after IVF and 26.4% after ICSI[4] it is clear that there have been tremendous developments within these two methods of assisted conception in recent years. It is also clear, though, that in spite of the increases in success rates over the years, these are still relatively low.

- Present some data, explain the implications of that data .
- The final sentence is not a "so what" sentence in the sense that we teach it at Durham

  (I would argue that the final sentence in the paragraph above prefigures what comes next, rather than summarises or evaluates what came before).
- The length of paragraphs can also vary greatly in one piece of writing and this doesn't seem to be (much of) a problem, though overlong paragraphs are not a good idea.

Key considerations (7): Referencing

- Plagiarism is a big concern amongst STEM staff.
- However, there is considerably less referencing in STEM than we would expect (especially UG level).
- This does not seem to be a problem! Plagiarism more often is seen as copying work from previous students or poor integration of downloaded source material, rather than under-referencing.
- Referencing systems can be chosen by the students in some departments but not others (e.g. Engineers can use numeric systems such as Vancouver - or Harvard – or even IEEE).
- Students use a lot of journal articles and online resources to get the latest scientific information rather than textbooks, which date very quickly. Text books are not liked by markers after the first year (Aaron Woodcock said that this is the same in Chemistry at Reading University).
- Physics students at Durham really only need their error calculation textbook. Error calculations have to go into the Appendix of a lab report and there is an absolute maximum (2 columns = 1 page) but there is also a preferred length (1.5 columns in the UG first year). Students didn't realise this – this is the kind of thing you only learn by talking to markers.

First iteration: “English for Sciences”

Three lunchtime sessions held weekly:

1) Lab report writing
2) Essay writing
3) The finer details: how to improve your writing style

Tried to include short writing extracts from a wide range of sciences

- A huge range of students turned up (1st years to Post-Docs!)
- We had surprisingly positive feedback
- Of course students would have preferred discipline-specific sessions targeted to their levels of study
- Many requests for higher-level stuff
- Some suggested points made in Session 3 could have been integrated into Sessions 1 and 2
- Physics students pointed out that they don’t write essays - ever!

Second iteration: "Lab Report Writing for Physics"; "Lab Report Writing for Biology"

These three stages proved crucial for these two courses:

- **Interviewed a faculty member** in depth. Got access to the department websites, downloaded sample papers, asked for writing samples and any writing assistance handouts. Attended a lecture on Writing Skills for Physics to see how it differed from mine (more content-focused). Faculty member allowed me to photograph her undergraduate lab book and revision notes.
- **Worked with a genre analyst**. Sat with him as he analysed and noted the moves in three key sections of four Physics lab report samples (abstracts, intros, conclusions) and then got him to talk through what he had just done. This worked well because we had three high-scoring reports (over 70%) and one lower. It seemed that the problem with the lower one was that the abstract, intro and conclusion were minimal and too similar ; they did not "add value" to the lab report.
- **Tried my own analysis of the same texts.** Put whole thing into a table. This helped me and I could give the results to the students. We could not give the full lab reports themselves to the students as they were confidential. (Feel free to e-mail me if you would like to see the table).

Important points for EAP practitioners!

- STEM students already know the structure of lab reports so it is pointless teaching this (don't do this "match the section to its purpose" stuff that we often do with social scientists)
- However, 1st year UGs are not always sure how to differentiate the content and language of abstracts, introductions, and conclusions (this is very teachable , practicable and learnable)
- STEM students most often come to an ELC class because of:
  - logical content/ordering problems;
  - grammar & punctuation problems;
  - the need to cut in order to fit page limits.

We can also suggest more referencing if it's not clear to us where stuff in the lab report comes from.

Never assume...

- That disciplinary differences have finite boundaries: there are crossovers and similarities in many areas
  - Applied Maths is more like Physics than like Pure Maths;
  - Physicists look at similar phenomena to Engineers, e.g. circuits;
  - Maths can take the form of cosmology.
- That UG Modules within one scientific discipline are all the same or require the same style

  - 3 out of 4 UG 1st Year Biology modules at Durham are similar, but "Organisms & the Environment" has a looser style + lots of maths to calculate populations
  - Master's Engineering students have a compulsory module in Geology
- Students doing "Natural Sciences" will have to master several different styles (but they are aware of this, so make great informants!)
- Institutional differences can be vast **(so ask – see penultimate slide)**

As a non-STEM EAP practitioner

- Even an ELC non-scientist should be able to follow a paper, even if we can't understand all of it, if the paper is well-written
- In almost all cases it is OK for the EAP practitioner not to be a STEM expert (students don't expect that we should be: think ESP teaching). They are pleased to meet a "writing expert".
- Only one student out of each of my classes thought the Physics session would be better if it were taught by a Physicist (correct view, of course!)
- Some STEM students thought our sessions were more helpful than the Skills sessions they received from their departments (compulsory!) and one latecomer just assumed I was a member of the Physics faculty (bless!)

What can practitioners take away from all this?

There is much to be learnt from scientific writing that social scientists and arts/humanities students can use to improve their own writing:

1) **Clarity**
2) **Precision**
3) **Logical ordering of content**

– I think about this constantly in my own writing and when evaluating any piece of academic writing & use it as a teaching point in non-STEM classes (logical ordering of content is better than a zillion sentences starting with conjunctive adverbs).

– I tell non-STEM students to make friends with STEM students, especially Engineers! Get an engineer to read your essay and tell you if it's logically ordered...

And what about those lab reports in Engineering? (I promised you three STEM disciplines...)

Institutional requirements can completely supercede EAP notions of disciplinarity (especially if you're relying on books, articles, the internet to create your materials), as I discovered:

- Engineers at Durham don't write their lab reports up! They write in pencil in the lab book and the work is marked on the spot, section by section!
- We would have looked very, very silly if we'd tried to teach "Lab Reports for Engineers"...
- Thank goodness for students (always my best informants) – nobody at the ELC was aware of this...
- We will now write an "English for Engineering" course instead

How important is the practitioner in the materials design process?

- **All-important in some ways**

  (1) it’s hard to teach this stuff if you haven’t gone this deeply into it.

  (2) a vague interest in popular science doesn’t cut it in STEM classes.

- **Unimportant in others** (because you don’t assess the work, and the faculty and students will always know more than you do).

- **You have to be “the meddler-in-the-middle”** because you <u>can’t</u> be “the sage-on-the-stage” or even “the guide-on-the side”

so: your job is to mediate between faculty, students and texts

(See: Erica McWilliam, “Unlearning How To Teach”, *Innovations in Education and Teaching International,* 45:3, 263-269)

However, I'm not convinced that...

(1) as a non-scientist, I can take my lab report writing classes much beyond the First Year level without significant help from a student/faculty member.

(2) any more materials are even possible without a lot more text samples (published research reports are not the same as lab reports, or as a PhD thesis).

(3) I can really distinguish good scientific writing from bad in published works (so am asking my STEM students to send me papers they think are good).

(4) I could hand my materials over to other EGAP teachers and expect them to be able to deal with (e.g.) the finer points of STEM writing, or student questions during the session.

The answer? ESAP in partnership

(1) Team-teaching with faculty would be ideal...

(2) Working in partnership with students also works extremely well (you could team-teach with them too, especially at PhD level, and they could be paid for this).

As an EAP practitioner, even with a STEM background, you can't do this stuff alone.

Working in partnership with students is empowering both **for the ESAP teacher** and **for the student themselves.**