Scientific Writing for Environment Engineering Students in the Polytechnic University of Bucharest

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Abstract: - The basis of most academic and research work is the ability to construct a clear, convincing, comprehensive, technical essay. Scientific writing is a skill most environment engineering students need to develop, as it is not a natural ability, and it is poorly represented in the curriculum of secondary/high school instruction. It is possible to learn how to perform research and write scientific essays and research proposals effectively addressing a given topic and adequately supporting an argument with evidence. The result is commensurate with the intellectual effort devoted to this activity, with the amount of additional reading in the foreign language and with the level of native language communication skills. It also depends on the learners’ critical thinking habits, on debating styles and on previous experience with studying and producing texts. To a certain extent, the type of writing is determined by the particular field in which the student/researcher is engaged, but the general points of construction are similar for all subjects. This article presents the key steps I implemented in teaching scientific writing and academic research skills to environment engineering students in the Polytechnic University of Bucharest.

Key-Words: scientific writing, stages & achievement, environment engineering, foreign language communication

1 Introductory definition of terms

Essay writing requires practice, revision, dedication and thoughtful consideration. In French the word means to try. It is defined as the writer’s attempt to explain, interpret, or depict objects and phenomena, and, by doing so, both learn and inform.

1.1 Paragraph writing strategy

As a result of gaps in both native & foreign language syllabi, environment engineering students in the first year do not possess adequate paragraph writing skills or argument layout abilities. They also seem to lack experience in formal style implementation and in selecting key technical information from a scientific text. The way they express ideas in the foreign language is characterized by simplicity, approximation and repetitive constructions. As a result, they are tempted to plagiarize others’ essays for both information and communication styles, as they distrust their own capacity of constructing sentences and messages.

What one knows clearly, one can write explicitly; therefore, students’ lack of appropriate & effective writing skills is indicative of mediocre learning techniques, reduced attention and intellectual effort span, poor note-taking strategies, or insufficient independent effort. Such abilities must be improved, so as to ensure effective professional development, and it all begins by putting ideas in predictable and logical order in a paragraph.

The correct paragraph begins with the main idea (the topic sentence), clearly and briefly formulated, goes on with the supporting arguments (examples, explanations, illustrative features, events narrated in key stages, relevant statistics), ending with a partial conclusion and a transition to the next paragraph, connecting the issues on debate by means of text markers for an easy to follow demonstration.

1.2 Types of essays

Essays are short texts written to state the writer’s interpretation/analysis/opinion/experience regarding a single topic. Popular as assignments, they require the author to include a research component and to synthesize personal knowledge and ideas, presenting it all coherently. An important distinction: a research paper investigates a topic or makes an argument by presenting the opinions of several scholars; an essay only presents the author’s personal ideas, incorporating research to highlight the writer’s own views.

There are several types of essays, but they can be divided into two types: academic and creative.

Academic essays approach a topic in a critical way and present the author’s thoughtful views:
• argument essays
• analysis essays
• interpretive essays
• research essays
• position essays
• critical essays

Creative non-fiction essays (in books, journals, composition classes) present the writer’s individual experiences/perceptions using carefully chosen and aesthetically presented language:
• personal essays
• descriptive essays
• humorous essays
• narrative essays

Whether they are academic or creative, essays have a thesis (main point/idea). In academic essays, it is a claim/argument articulating the writer’s view on the topic. In creative ones, it is implied. Regardless of whether it is academic or creative, however, the thesis of the essay should be apparent to the reader and developed through the examples, analysis, and commentary presented in the course of the essay. The essay should always end by remarking on that thesis without summarizing or repeating it.

1.3 Research paper format

It represents the particular structure and arrangement a research paper takes, and differs across disciplines, since research papers in varying fields have different structural and stylistic needs. In addition, research paper formats may differ according to the demands of particular instructors/subjects. However, most research paper formats can assume to take some variation of the format outlined below.
• contextualizing introduction
• thesis paragraph
• development section of several pages, presenting valid research supporting the thesis statement
• conclusion, suggestions and implications of what the research in the paper revealed about the thesis
• distinguishing characteristics:
  1. progress goes from general to specific
  2. never creative in information presentation
  3. providing background & contextualizing data for facilitating understanding and readability
  4. gradual investigation of complex ideas
  5. assisting the reader in following the claims, arguments, and examples made in the paper
  6. specific sections labeled with headings

2 Problem Formulation: essay design stages for environment engineering

Here follows a grid I devised for the first year environment engineering students, in response to their difficulties in approaching scientific writing:

2.1 Analyzing the question

Closely analyze the question and the topic. It is surprising that many students should simply write down everything they know about a subject without reference to the actual requirement.
• Examine the key words in the question (examine, develop, analyze, influence, compare). They indicate how to proceed with the essay.
• Be aware of whether the question requires your own opinion in isolation or whether it asks you to assess the previous and current thinking on a subject and follow this up with a conclusion summarizing your own thoughts (the latter is more usual).
• Monitor if you are answering the question without reeling everything you know about the given topic.
• Mind the choice of texts, word count and style
• Research data and critical opinion before writing.

2.2 Researching the topic

• Gather evidence avoiding plagiarism and unclear delimitation of personal/others’ ideas.
• Compile an alphabetical list of all books used at this stage, saving time with references & bibliography later, also keeping track of evidence sources. Present them in the required academic style.
• Keep balance between evidence supporting your ideas and evidence apparently contradicting them. Display awareness of all points of view (within reason), not just those that agree with your own.

2.3 Planning

• Never omit this stage; it saves time, being essential for a structured, reasoned and researched response.
• It derives from the question & the key words in it.
• Consider collected evidence versus the question all the time in which you are conducting the research.
• Decide what evidence to use and what to discard (often interesting evidence has to be omitted simply because it is not relevant).
• Avoid exceeding the specified word count
• Ensure that all your evidence is really related to the ideas and to the topic concerned.
• Make a rough plan or diagram of your essay: write down paragraph headings and which evidence you will use where. It facilitates coherence, concision and logical demonstration.
• Reveals potential gaps in evidence or in linking connections, which can be solved before it is too late

2.4 Writing the essay

• Mind spelling, grammar and punctuation.
• Use all assistance available via modern technology (still, computer spell & grammar check is not infallible)
• check with other resources and proof-read or get someone else to do it, in case of overlooked mistakes
• Choose: either write the main body first, then go back to construct your introduction, or write the introduction first, followed by the main body of your essay. Both have advantages & disadvantages based on how closely you can stick to the stated thesis: if you feel you might deviate from the introduction then write the introduction later, because then you can adapt your thesis accordingly.

2.5 Introduction
• Relevant, interesting for the examiner
• Balanced in size: not too much not too little
• Set out clearly the personal response to the topic and how you are going to present and demonstrate it
• To the point, without quotations (you present your response, not somebody else’s).

2.6 Main body
• Each paragraph represents a separate but related aspect of the main topic of the essay.
• Write each paragraph almost as though it were under a sub-heading to the main title and supplement each of your points with collected evidence.
• Four or five sentences long.
• The evidence should also be analyzed. It means commenting on individual data of particular interest or importance. It brings extra marks & additional lines of thought, helpful/relevant to the main argument.
• Short quotations in the requested referencing style.
• End a paragraph with a connection to the next, for better flow and an impression of a pattern, ultimately leading to the conclusion: an idea introduces the next, followed up by subsequent reference to the link.
• Paragraphs should move on using the basis of furthering the argument. This can be achieved in several ways: sequential writing (one event follows naturally from another), elaborative writing (develop a point made previously), contrasting/comparing, (an idea contradicts/questions the preceding paragraph).

2.7 Conclusion
• It is a summation of the argument.
• Marks are lost for an abrupt conclusion, for overlooking the implications of the global argument, for contractions/omissions due to space limitations.
• It is acceptable to use quotations in conclusions
• Do not introduce new ideas at this stage.
• No further information is necessary.
• Provide a generic context to your specific thesis
• Tie up any loose ends that might have occurred during the writing of the essay.

2.8 Stylistic features
• Never use the first person unless specifically asked to (avoid I think or in this essay I am going to).
• Presentation in an objective manner.
• Never use colloquial expressions, keep Standard English throughout.
• Avoid lists unless the essay specifically requires them, as they seem rushed/truncated presentations of information without sufficient explanation.

2.9 Final checks
• Listen to your essay read aloud, to follow ideas, connections, coherence and relevant logical flow, to verify clear, well-referenced & structured arguments
• Fix typos.
• Ensure correct referencing of quotations
• Bibliography is important, as evidence of research and wider reading, demonstrating that you recognize the importance of acknowledging sources (note full publication details of consulted books and the time).
• Follow instructions carefully (style, word count).
• Get readers’ interest by means of combining thorough, factual research & engaging, interesting style.

3. Problem Solution: the structure of the environment engineering essay

There are a number of reasons for writing an engineering essay: as part of course assessment, as an application to a conference, for publication in a journal, or just for personal professional progress. A clear decision must be made on the objective before structuring the essay, and it should be kept in mind, together with audience’s aims, throughout writing.

3.1 Typical Structure
A typical structure of an engineering essay has the following rubrics:
• Abstract: a concise summary, interesting enough for the reader to continue. It includes background, a brief statement of the objective/purpose, the methods, the key results and the conclusion or implications of these results. It is written using the past tense.
• Introduction: background information, research relevance & novelty, objective, definition of current knowledge boundaries, up-to-date literature review. Refer to other peoples’ work and do not plagiarize work or ideas; this is a serious offence.
• Materials and Methods: enumerate the steps taken in achieving the objective. Do not detail any results. Briefly present the techniques/methods and justify the approach/path of investigation. Describe statistical methods or analysis techniques used to interpret the results. In the case of experimental
work, show equipment & methods. Include sufficient details so that the experiments can be reproduced in the readers’ own lab. In the case of a stress analysis problem, say how you modeled the problem, what assumptions/simplifications you made, the boundary conditions and material property considerations.

- **Results:** use images and graphs, correctly labeled with scales and units. Include detailed captions.
- **Discussion** brings the reader back to the objective and describes how the results obtained relate to it. Explain findings and any anomalies you have come across. Relate the results back to previous work and to the bigger picture. Include plans of further work.
- **Conclusion:** a summary of what you have already presented, even in bullet point list format.
- **References/Bibliography** according to the required reference

**In Summary:**
1. Make a plan before you start
2. Define your objective & audience
3. Reference your work
4. Do not plagiarise
5. Check spelling, punctuation, grammar
6. Read your engineering essay through before you submit it.

**3.2 Tips for students**

- Use the question as an anchor that will give you the precise way to approach the task
- Select methodology according to the basic key words frequently used in essay writing question:
  1. compare – noting the differences and similarities in texts or topics
  2. contrast – as above, but with closer reference to differences
  3. analyze – comment on specific aspects of texts and/or topics in detail
  4. assess/evaluate – an overview with a judgment made as a conclusion
  5. describe – similar to an assessment but not necessarily requiring a judgment
  6. identify – usually looking for specified details and commenting on them
  7. All of the above might typically have the word ‘critically’ attached to them

For example, in the case of comparing issues, there would be two basic ways to proceed: writing about each one in turn and saying how they differ from one another; writing about themes that are common to both and applying them to the texts. The latter is more difficult but it is the most effective, as it avoids useless repetition. However, the topics need to be known very thoroughly in this type of essay writing because you have to switch back and forth between the two discussing different themes in each paragraph.

- research and plan the essay in order to obtain properly structures and documented work.
- look up key texts in the area you have to address. Specific texts may even appear in the question
- Make careful notes on such texts, which can be used as evidence in your essay writing as support. Also note carefully when gathering evidence to avoid accidental plagiarism
- Note down full details of any books consulted, not just those from which you quote. Adhere precisely to the required citation style or you will lose marks.
- Use annotated bibliographies. This is not cheating; it is just using a source available to all. In fact, if you cross-reference texts you will see that critics tend to have texts in common, so what you are doing here is just good academic research. The advantage of using texts that have been used by established experts in the field is that you will have the reassurance of knowing that when you are using evidence in your essay writing, you will be using texts with both integrity and authenticity.
- When planning the essay, use the brainstorming technique, noting everything you can think of that relates to the topic and then divide these up into what goes best together. Color coding can help. Attaching reference to quotes and ideas saves time.
- Structuring and composition: most academic essays are a variation on the basic five paragraph essay, with the introduction (1 paragraph), the main body (3 paragraphs), and the conclusion (1 paragraph).
  - Written in accurate Standard English
  - Well supported by textual evidence and analysis.
  - In the introduction to an academic essay mention the three vital elements: the thesis statement, the methodology, and the main texts to be used.
  - Pay particular attention to the opening sentence and the thesis statement, often one and the same.
  - The main body is series of linked paragraphs each addressing a different aspect of the topic without losing sight of the central argument. Connecting sentences link the paragraphs providing a hook to be picked up by the next paragraph in the main body.
  - There are two styles for in-text referencing:
    a. **Parenthetical Referencing:** in brackets, listing the author, date of publication and page number, placed immediately after the quote and identified via the bibliography/reference list at the end of the essay
    b. **Footnotes & Bibliography:** a superscript number is placed next to the quote and linked to a footnote at the bottom of the page giving details of author, title, publisher, publication place and year, page number.
• The conclusion is the last chance to impress, just as the introduction was the first. It should contain all of the following: summary of the main points of the argument, synthesis of your thinking, indications of limits of the present work (taking a critical look at your own essay), and what direction further study might take (a chance of picking up marks, because if you prove capable of further research by identifying future areas of study, you stand out as a student who is likely to do post-graduate work).

• Effective editing: do not correct as you go, but simply mark mistakes and then return to correct. This achieves 3 objectives: you note the frequency of mistakes and thus avoid them in future; you get a sense of the flow of argument uninterrupted; you identify referencing mistakes (in referencing style or failing to provide sufficient evidence or analysis). You might also find areas where you have buried a potentially important point by placing it badly or structuring clumsily.

• Remember that none of us is born with the ability to write an essay, we all learnt the skill, mostly by trial and error. Once you can handle the basics, then essay writing just gets better and better as you add experience to your knowledge.

3.3 Writing environment research proposals

A research proposal is a formal document that a student writes with the intent of getting permission, sponsorship, or funding to perform research. It is a basic statement expressing desire to perform specific research. Such documents are often used in higher-level educational programs, (graduate school or PhD) where intense research is both expected & required.

Research proposals vary, depending on the type of research that the student wishes to perform, the level of academic study, the educational institution that will sponsor the research, and the depth of the research. Many funding and sponsorships programs also have their own specific criteria for information that should be included in a research proposal.

All research proposals should at least include:
• a statement about the purpose of the research
• if the student is equipped to perform the research
• background information about the research topic
• information about the relevance of the research
• overview of methods used in performing research
• research goals
• research budget, with details, financial estimation, exact modalities in which the research project will benefit from the allotted money.
• the student requiring sponsorship from a professor or university states why the professor/university is the appropriate sponsor for the research project.

• Research proposals should also indicate what is required of the sponsor, such as regular research reviews, access to research facilities, or even simply credibility through association.

• A research proposal written by a student in order to get permission to perform research, is directed to a professor/academic institution and includes similar information to research proposals for sponsorship. However, a research proposal requesting permission is often required simply to provide a record that the research will be performed.

• A research proposal is similar to a grant proposal in many ways (in fact, many grant proposals are also research proposals when the grant involves research to be performed, but a grant proposal always asks for funding, while research proposals only sometimes). A research proposal is a basic statement of intent or desire to perform research and it asks for permission, sponsorship, or funding only in some cases.

4 Conclusion

All the steps I have taken so far in teaching scientific writing to environment students have been aimed at setting standards and cultivating skills required for original work and fair behaviour during university years & the future career. My main didactic concern has been to increase awareness as far as plagiarism is concerned, and to develop students’ critical thinking and debate abilities, together with their originality in approaching technical issues.

Here are some strategies I found useful:

• Rejecting student work consisting predominantly of others’ words or ideas.
• Steering students clear from following the words of a source too closely, without quotation marks, as it still is plagiarism, even if the source is cited.
• Discouraging learners from selecting the same essay topics. While it is possible that students might write on the same topic as someone else, odds are that they will not have exactly the same ideas or express them in the very same way.
• Pointing out that accidental plagiarism from sources read and long forgotten may happen.
• Informing students on sanctions for plagiarism in academic settings, handled by individual instructors and the academic institution involved. If, however, the plagiarism involves money/prizes/job placement, it is a crime punishable in court. Most colleges and universities have no tolerance for plagiarists. In fact, academic standards of intellectual honesty are more demanding than copyright laws. Plagiarized papers result in assignment or course failure, or expulsion.
• Explaining the difference between a legitimate paraphrase and a plagiarized one, between a proper
citations and improperly using them, by distributing examples of plagiarism and legitimate work, and then go over the differences together. This clarifies common misconceptions about plagiarism and reduced the likelihood of honest mistakes, at the same time showing how serious the issue is.

• Stating that plagiarism undermines principles of trust & respect, vital for education & professionalism.

• Making students aware that they hurt themselves, failing to acquire the research/analytic/writing skills they could learn by doing the assignment honestly.

• Increasing awareness on the fact that plagiarism hurts those classmates who have legitimately earned their grades and degrees, and who will be competing with plagiarizers for school admissions and jobs.

• Informing students on the risks of plagiarizing.

• Setting clear expectations: to produce thoughtful, original work, not just collect the best information possible for an assignment. Good research is critical, and the ability to transform the information they find into an original and persuasive argument is more important than coming up with the best sources. The skills they learn in working to further the ideas and arguments of others are a valuable part of what they will take away from their assignments.

• Establishing certain rules in advance, on students’ collaboration, on bibliographies, on the number of sources cited/referenced, on online sources & books.

• Assigning specific questions or topics: the more particular the questions, the less likely students are to find papers already written on them. To avoid restricting students' creative freedom, there was an option allowing students to develop their own topics.

• Requiring students to submit thesis statements, introductions, outlines, or drafts, checking progress during the process of composition and commenting on what they submit, so as to monitor how they respond to feedback and whether their papers show the flexibility of works-in-progress.

• Asking students to summarize the content and usefulness of their sources in few sentences, pointing to the fact that annotation has to be in their own voice and words, discussing the relevance of the source to their research. It is easy for honest students. Plagiarizers, however, find it considerably difficult.

• Assigning oral presentations with questions on the process of researching and developing their ideas.

• Requiring recent sources which most papers from online paper mills and other cheating databases do not have, as they are already several years old at best.

• Assigning a paragraph on the composition process explaining how they arrived at their topic, how they began researching it, what criteria they used for evaluating their sources, and what they learned from the research project. This gives an idea of how well they have comprehended the material and the degree of fluency they have in speaking about it.

• Encouraging concision and focusing on the substance of their claims rather than the length of their writing.

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