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Developing technical writing skills to engineering students

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Abstract

The most important aspect to consider when writing a technical document is that it is essentially different from a "general" document in terms of its objectives and audience. In terms of methodology, the acquisition of writing skills within the frame of technical English inevitably follows the patterns of general English language acquisition, to which one should add some specific features dictated by the specialized uses of the technical discourse. In this respect, ESP teachers encounter the insufficiently exploited challenge of adapting the methodological tools to the specific needs of the Engineering students. The study presents the specific features of the most popular forms of written technical communication models and suggests some methodological resources which the ESP language instructor may adopt in order to build and reinforce engineering students' writing skills. The objectives of the present study are to introduce, define and explain the task of writing technical documents and highlight the importance of these types of texts in the activities related to an engineer's specific responsibilities both in a professional environment and during training; to outline the specific character of technical documents and to present and explain methodologies which can be used in teaching technical English writing skills.

Keywords: ESP; Technical English; methodology; technical discourse; technical text.

1. Introduction. The importance of functional writing.

The most important aspect to consider when writing a technical document is that it is essentially different from a "general" document in terms of its objectives and audience. "The fundamental purpose of scientific discourse is not the mere presentation of information and thought but rather its actual communication. It does not matter how pleased

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an author might be to have converted all the right data into sentences and paragraphs; it matters only if a large majority of the reading audience accurately perceives what the author had in mind" [1].

Writing is not engineering students' favorite activity. Given the specifics of their professional formation, they are rather people of action rather than of words. However, there are many instances in their professional lives when they are required to write various types of texts. Some of them are general writing texts which any professional is bound to write occasionally in order to facilitate communication at the workplace, with the co-workers, employers or clients. These may be letters, memos, emails. Other types of texts are more specific, relating to the characteristics of the job. Among these we mention the technical report, the laboratory report, technical procedures and operations, product descriptions, technical manuals.

Given the specific features of the academic training that future engineers must acquire, the language instructor should perform a careful selection of the teaching material. His or her choice of text types must facilitate the development and practice of students' general writing skills but, at the same time, the instructor has the responsibility of equipping students with relevant experience which the students can put to practical use when they enter the labor market. In this respect, Adriana Vizental [2] distinguishes between three types of writing practice for students:

- functional writing (memos, advertisements, application forms, letters of complaint, CVs), aimed at developing practical writing skills with a more general application, in practically all professional domains;
- academic writing (compositions, essays, research papers, reports, dictionary or encyclopedia entries);
- creative writing (diaries, informal letters, articles, short stories).

When practicing skills writing with engineering students, the selection should include types of texts belonging to functional and academic writing. These categories would best serve students' professional purposes. However, the task of equipping the students with theoretical and practical abilities enabling them to produce accurate texts is many times hindered by several obstacles. Among these, the most common are:

- Students' language proficiency is insufficient for the task.
- Writing in general and technical writing in particular is a complex and laborious process requiring commitment and specialized skills.
- In some cases, students do not have sufficient knowledge of the topic they approach in writing.
- Functional writing may be a tedious activity.

Despite these obstacles, one must not neglect the importance of functional (specialized) writing at the workplace. Even in the case of such a practical activity as engineering, communication skills rank first among an employer's expectations from his/her employees. Technical writing abilities are considered to be crucial for success [3] and are seen as more important than spoken interaction in an organization.

The present paper is an attempt to suggest some methodological resources which can be used by language instructors teaching engineering students in order to stimulate and motivate them to produce efficient functional texts.

2. Characteristics of technical document writing

When writing technical documents, engineers are required to obey a set of norms which are characteristic of this type of texts. Since these texts have an extremely practical purpose, it is essential that their message should be communicated accurately to the audience. This task is made easier if the technical document writing process is approached bearing in mind specific structures and following a clearly defined plan.

In order for the reading audience to accurately receive the message, the author must obey some rules of technical document writing. Among the most relevant ones we mention:

2.1. Planning.

Planning the text before starting to write it is a rule which applies to all writing activities. This is especially important in the case of writing technical documents. When planning their text, whether it is a product description or an operation procedure, the students should first make sure that some preliminary phases have been completed:

- the audience has been identified: the choice of vocabulary depends on the nature of the audience. A text written for professional audience will differ significantly from a text written for the general public.
- the purpose and the material is known. The author should clearly identify the purpose of the text: to inform, to persuade, to instruct etc. Also, the author should be familiar with the material of the text.
- the author understands the writing task.
- ideas and material are organized. The author should make notes with the most relevant ideas and the material should be organized around them. One idea should be approached and dealt with in one paragraph / chapter / subchapter.

2.2. Clarity

Since the most important objective of a technical text is that of transmitting information, the students must make sure that the information is not affected by the use of professional jargon (specialized vocabulary, abbreviations). The selective use of professional jargon is dictated by the audience of the written text. If the audience is composed of professional people who are familiar with the material, the subject and the terminology, selective professional jargon may be used as long as the understanding of the text is not hindered.
E.g.1: "For the first year, the links with SDPC and HAC were not connected and all required OCS input data were artificially loaded. Thus CATCH22 and MERWIN were not available".
E.g.2: "Because some links in the computer system were not connected the first year, we could not run all the software codes"[1]
In order to observe the same rule of clarity, the unfamiliar terms must be defined. If abbreviations must be used, the terms must be defined in their first occurrence and the abbreviation is put in parentheses.
E.g. "Computer-aided design (CAD) is the use of computer systems to assist in the creation, modification, analysis or optimization of a design"[4].
Equally, the first occurrence of unfamiliar terms must be italicized and defined:
E.g.: "*Matlab* (*mat*rix *lab*oratory) is a numerical computing environment and fourth – generation programming language"[5].

2.3. Brevity.

Brevity refers to the efficient use of words. A technical text is essentially pragmatic and to-the-point and implies the avoidance of unnecessary words. The following aspects should be considered for brevity reasons:

- The texts should be kept at the minimum length required for understanding.
  E.g.1: "The relationship between the nature of salt water to fresh water in the Edgartown Pond that fluctuates often is extremely important to everyone including scientists, residents and environmentalists on Martha's Vineyard".
  E.g.2: "The fluctuating salinity of EGP concerns many environmentalists, scientists and residents". [1]
- The key information should be kept in the main clause:
  E.g.1: "Despite some problems with measurements due to inappropriate physical conditions, the experiment was a success".
  E.g.2: "The experiment was a success, despite some problems with measurements due to inappropriate physical conditions". [1]
- Overlapping sentences should be combined.

E.g.1: "Water quality in the Hawk river declined in March. This decline occurred because of the heavy rainfall that month. All the extra water overloaded Tomlin county's water treatment plant".
E.g.2: "Water quality in Hawk River declined in March because heavy rainfalls overloaded Tomlin County water treatment plant". [1]

2.4. Simplicity

Details should be wisely used.
E.g.1: "The number of particular hydrocarbon combinations in our study is enormous. For example, the number of $C_{20}H_{42}$ is 366,319 and the number of $C_{40}H_{82}$ is 62,491,178,805,831".
E.g.2: "The number of hydrocarbon combinations in our study is enormous. For example, the number of $C_{40}H_{82}$ is over 60 trillion". [1]

2.5. Word choice

Students should pay attention to word order.
E.g.1: "In abnormal functioning conditions we tested the performance of the device".
E.g.2: "We tested the performance of the device in abnormal functioning conditions".
The language should draw students' attention to the overuse of the pronouns IT and THIS, because it is sometimes difficult to identify the antecedent.
E.g.1: "When a short circuit occurs, a large current flow through a fuse or circuit breaker will open the circuit, blowing it".
E.g.2: "When a short circuit occurs, a large current flow through a fuse or circuit breaker will open the circuit, blowing **the fuse**".

2.6. Active voice

Although the use of the passive voice in technical texts was considered to be more appropriate, due to the objectivity and higher degree of formalism which a technical document implied, in recent years we have witnessed a reconsideration of the use of voices in technical writing, with a clear preference for the active voice: "the passive voice requires more words than the active voice to convey the same information and it conceals who or what does the action." [6]
Compare the following examples:
E.g.1. "A new process for eliminating nitrogen oxides from diesel exhaust engines is presented. Flow tube experiments to test this process are discussed. A chemical reaction scheme to account for this process is proposed".
E.g.2. "We present a new process for eliminating nitrogen oxides from the exhaust of diesel engines. To test this process, we performed experiments in flow tubes. To explain this process, we developed a scheme of chemical reactions".[1]

3. A methodological example of practising technical writing skills

When faced with the challenge of developing engineering students' writing skills, the teacher should resort to authentic materials. This is the first important condition which must be fulfilled. Authentic materials arouse interest and motivation; they are something that students can relate to and they can see the practical objective of the writing task. Authentic materials are stretches of real language, produced in real professional contexts.
Figure 1 is a scheme representing the process of producing energy from coal. This input material is appropriate to be used with electrical engineering students, especially with the Power Systems Engineering students. However, students from other engineering domains might as well practise their writing skills having this figure as a visual input.
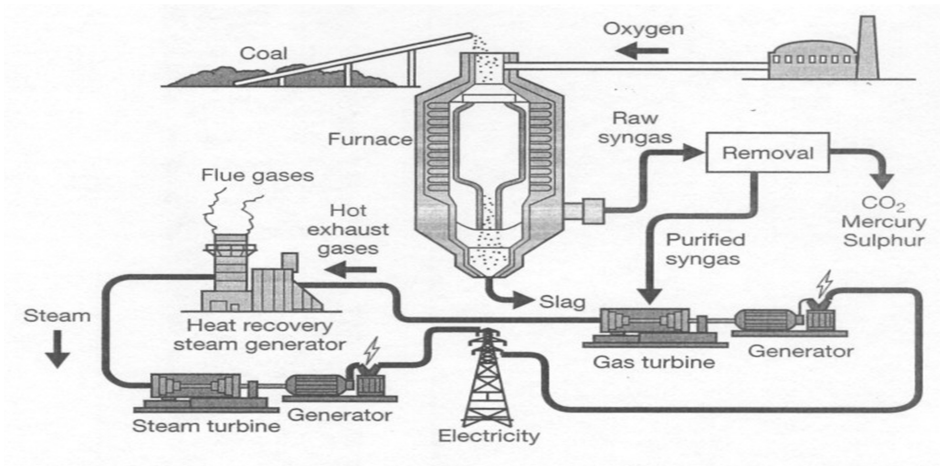
Fig.1 Producing energy from coal (Source: *Improve your IELTS Writing Skills*)

According to the students' English language proficiency, several possible methods of practicing writing skills may be applied.

- Look at figure 1 and answer the following questions:
  a.   How is the coal carried to the power plant?
  b.   What is added to the furnace in addition to coal?
  c.   What gas is produced when coal is burnt in the furnace?
  d.   What is removed from the gas?
  e.   What is the gas called following this process?
  f.   What does the gas do in the turbine?
  g.   What does the turbine do to the generator?
  h.   Where do the hot exhaust gases come from?
  i.   What happens to the gases?
- Based on the representation in figure 1, write a paragraph describing the process of producing energy from coal.
- Choose the correct alternative in each case:
  First of all / At first / One the coal is mined in deep pits underground and then carried to the surface. *Furthermore / after that / as a result*, it is carried along a conveyer belt to a power plant, *when / then / where* it is burned in a large furnace to which oxygen is added. *Otherwise / from this / therefore*, raw syngas is produced. At the next stage of the process, harmful substances like carbon dioxide , mercury and sulphur are removed. *Following that / following / subsequent*, the purified gas is used to drive a gas turbine. The turbine, *in turn / afterwards / therefore* powers a generator, producing electricity. The gas turbine also produces hot exhaust gases. These are *then / therefore / consequently* piped to a heat recovery steam generator, which converts the heat into steam. The steam is *consequently / subsequent / subsequently* used to power a steam turbine, which again is used to generate electricity. The energy is clean because harmful products are removed and the coal is not transported to another site to produce electricity.
- Put the verbs in brackets into the passive voice:
  At first the coal **(mine)** in deep pits underground and then carried to the surface. After that it **(carry)** along a conveyer belt to a power plant, where it **(burn)** in a large furnace to which oxygen **(add).** From this, raw syngas **(produce)**. At the next stage of the process, harmful substances like carbon dioxide, mercury and sulphur **(remove).** Following that, the purified gas **(use)** to drive a gas turbine. The turbine, in turn, powers a generator, producing electricity. The gas turbine also produces hot exhaust gases. These then **(pipe)** to a heat recovery steam generator, which converts the heat into steam. The steam subsequently **(use)** to power a steam turbine, which

again **(use)** to generate electricity. The energy is clean because harmful products **(remove)** and the coal **(not transport)** to another site to produce electricity.

- Look at figure 1 describing the process of producing energy from coal and correct the mistakes in the following text:

   At first the coal is mined in deep pits underground and then carried to the surface. After that it is carried along a conveyer belt to a power plant, where it is burned in a large furnace to which raw syngas is added. From this, oxygen is produced. At the next stage of the process, hot exhaust gases like carbon dioxide, mercury and sulphur are removed. Following that, the steam is used to drive a generator. The generator, in turn, powers a gas turbine, producing electricity. The gas turbine also produces slag. This is then piped to a heat recovery steam generator, which converts the heat into steam. The steam is subsequently used to power a gas turbine, which is again used to generate electricity. The energy is clean because harmful products are removed and the coal is not transported to another site to produce electricity.

4. Conclusions

Developing writing skills among engineering students is not one of the language instructor's easiest tasks. The reasons lie in the nature of the technical writing process, which is a complex and elaborate one. However, the language instructor may provide motivation by pointing out the role of writing technical documents in real situations, in professional contexts. By ensuring that students can constantly exercise their writing skills in a variety of real contexts, starting from guided writing (note completion, summaries, fill-in, closes) to more complicated tasks requiring them to produce full paragraphs/texts, the students will acquire the necessary experience, both theoretically and practically, which will enable them to function adequately in a professional environment.

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