The Nature and Role of Specialized Vocabulary: What do ESP Teachers and Learners Need to Know?

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Introduction

In the 25 years since Meara (1980) described vocabulary as "a neglected aspect of language learning," interest in the field of lexical studies has grown to such an extent that it is now difficult not to feel overwhelmed by the quantity and scope of research in the area. The English for Specific Purposes (ESP) field is no exception, and questions are increasingly being asked about the role played by the specialized vocabulary needed for academic study (see, for example, Chung and Nation, 2003; Coxhead, 1998; Sutarsyah, Nation, and Kennedy, 1994; Ward, 1999). Despite the burgeoning interest in recent years, however, a question mark still remains over the precise nature of the vocabulary that needs to be taught in ESP courses, and how best to teach it. This is a particularly important issue at the tertiary level in Japan, with university educators becoming more and more aware of the need for effective ESP programs to provide students with the English they require in a variety of academic and professional contexts.

The Vocabulary of Specialized Texts

A technical word is essentially one that is "recognizably specific to a particular topic, field or discipline" (Nation, 2001: 198). A more precise definition of specialized vocabulary has been given by Salager (1985: 6), who states that in the field of medicine it consists of "those high-frequency, context-bound, or topic-dependent, terms particular to a given medical specialty." Often only the teachers, practitioners, or students of a subject will be familiar with this store of words used regularly in a particular subject area, which are most often found in science textbooks or research papers.

Clearly, for learners with specific goals, knowledge of the technical terms associated with a particular field of study will be necessary, and this type of vocabulary is an obvious focal point in any examination of the lexis of scientific texts. Indeed, there may be a temptation to believe that a mastery of technical terms is all that is required for success in ESP reading, and that these are the words we should teach. Several writers (e.g., Barber, 1962; Cowan, 1974), however, hold the view that learning the meanings of technical words is an automatic consequence of studying the discipline which uses them, and the emphasis has shifted to the category of words that are most commonly termed "subtechnical" or "semi-technical" vocabulary. There is a lack of agreement, though, as to exactly what kind of words should be included in this group.

The term "subtechnical" for categorizing vocabulary was introduced by Cowan (*ibid.*), who defined it as "context-independent words which occur with high frequency across disciplines." Martin (1976), while agreeing with this definition, preferred to call this group of words "academic vocabulary." Trimble (1985) extended Cowan's definition to include common words which occur with specific meanings in particular scientific and technical fields, for example *fast* (as in *arsenic-fast virus*) used with the sense "resistant to."

A number of workers have attempted to quantify the vocabulary of scientific tests using computer-aided frequency counts and statistical analyses. Inman (1978) carried out one such study of a 114,000-word corpus from professional journals, divided into 10 scientific and technological fields. Following Cowan's definition, Inman classified words with low distribution across fields as "technical" (21% of the corpus), and after identifying "function" words (9%), considered the remainder (70%) to be "subtechnical" words. A list of the most frequent of these subtechnical words included *result, process, system,* and *function.* The problem with this categorization is that the 70% of words considered to be subtechnical comprises everything in the texts that is not a technical or function word.

Yang (1986) describes a computerized method of identifying scientific/technical terms using a corpus of 300,000 words. He found that words with high distribution and high frequency tended to be function words, and if they showed a peak of frequency in one field, they would tend to be a technical term. The remaining words (lower frequency with high distribution) were identified by Yang as subtechnical — words such as *factor, problem, conclusion* and *disease.* Yang also found that there could be overlap between subtechnical words and technical terms. He found *solution,* for example, to be a subtechnical word because of its high distribution. However, *solution* is also found with peak frequencies of occurrence in the fields of chemistry and mathematics.

An alternative approach to identifying the different kinds of vocabulary used in specialized texts is to rely on intuitive judgment in order to draw up different categories of words. One of the first researchers to do this was Mona Baker (1988), who investigated subtechnical vocabulary in medical journal articles. After discussing the various definitions of this category of vocabulary, she brought them all together in a list:

(1) Items which are used to express notions general to specialized disciplines, e.g., *factor, method,* and *function.*
(2) Items which, in addition to their meaning in general language, have a specialized meaning in one or more disciplines, e.g., *bug* in computer science.
(3) Items which are not used in general language but which have different meanings in specialized disciplines. *Morphological,* for example, has different meanings in linguistics and botany.
(4) General language items which have restricted meanings in certain specialized disciplines. For example, in botany, *effective* simply means *take effect.*
(5) General language vocabulary items which are used frequently to describe technical processes and functions.

(6) Items which are used in specialized texts to perform specific rhetorical functions. These signal the writer's intention or his evaluation of the material presented.

In Baker's view, the last type of subtechnical item is the most important and also the most difficult to acquire. She believes that a knowledge of rhetorical/organizational lexis is important if learners are to develop a sense of style relevant to the various text types used in their specific disciplines, and to be able to interpret and evaluate an argument or piece of specialized information. In her analysis of medical journal articles, Baker arrived at a list of 65 items considered to have a potentially significant role in structuring the writer's argument. Her list contained words such as *findings, report, diagnosis*, and *evidence.*

Baker's category of subtechnical/rhetorical lexis appears to have much in common with what McCarthy (1991) calls "discourse-organizing words." According to McCarthy it is the job of words such as *problem, issue*, and *assessment* to organize and structure the argument of a text, rather than answer for its content or field. Some of these words in fact indicate the larger text patterns that the author has chosen, and allow the reader to predict the shape of the whole discourse. Such words, then, are clearly very important, as the language learner who is not familiar with them may find it difficult to decode the whole text efficiently.

Some linguists have attempted to define more precisely sub-sets of words in this lexical area. Winter (1978), for instance, identifies "Vocabulary 3" words, which act as "lexical" items of connection. This list includes words like *identify, technique, function*, and *hypothetical.* These items closely paraphrase basic clause-linking relationships, such as *reason* in a context like "He left for the reason that he did not like it there," where *for the reason* could be replaced by *because.*

Subtechnical/rhetorical lexis is also linked to the category of "anaphoric nouns" put forward by Francis (1986). Francis gives extensive examples of nouns that frequently occur to refer back (and sometimes forward) to chunks of text. These nouns operate as pro-forms and are presented as the given element in a clause containing new information. Words such as *hypothesis, interpretation*, and *viewpoint* fulfill these conditions. Fraser (2003) investigated the use of words such as these in medical journal articles, and his list of the most frequent anaphoric nouns included *findings, problems,* and *evidence.* The following examples show how anaphoric nouns can stand in place of segments of text, and that these segments may consist of a sentence or sentences, a whole paragraph, or even more:

(1) The *evidence* for pathogenic and protective roles of Vi is as follows: ...

(2) A report from Newcastle highlighted an increasing *problem* with intoxication in that city. Our study does not suggest a similar trend in Glasgow or Nottingham ... Nevertheless, the pronounced difference in the apparent size of the *problem* in our two cities, where hospital admission policies are identical, is intriguing.

In (1), *evidence* is being used to stand in place of a large segment of text which is to follow; in (2), the second *problem* refers back to the previous sentence, which in turn refers to another medical article.

Farrell (1990) created a list of what he considered "semi-technical" words, drawn from his 20,000-word Electronics English Corpus. In line with Cowan, he considers this category of vocabulary to be formal, context-independent words with a high frequency and/or wide range of occurrence across scientific disciplines, not usually found in basic general English courses. In recent years, a great deal of attention has been paid to this type of lexis, which, taking up Martin's (1976) terminology, is now most often known as "academic" vocabulary. A general academic vocabulary has since been identified by Coxhead (2000), whose Academic Word List (AWL) prepared from a corpus of 3.5 million words provides good coverage of a wide variety of academic texts. The words in the AWL are believed to be those which university students of English must be thoroughly familiar with for both reading and writing academic prose.

Lam (2001) also investigates semi-technical vocabulary, but she uses the term to refer to general words that take on extended meanings in technical texts. To add to the confusion, Chung and Nation (2003), who used a semantically-based rating scale to identify technical vocabulary, consider such polysemous words to be fully technical.

Clearly, although there is much agreement among researchers concerning the nature of technical and subtechnical vocabulary, the differing use of terminology is the cause of considerable confusion. Indeed, there is even uncertainty as to precisely which words should be considered technical or not.

Establishing Clearer Categories of Specialized Vocabulary

In an attempt to gain a better understanding of the different kinds of words that make up a specialized vocabulary, Fraser (2005) adopted Chung and Nation's rating scale methodology in a lexical analysis of two textbooks (pharmacology and applied linguistics). Although this approach is time-consuming, it was found by Chung and Nation to be the most efficient way of identifying technical terms. Also, having studied both subjects at the tertiary level, Fraser was able to make use of his knowledge in deciding the most suitable way to categorize the words.

Nation's RANGE computer program (available at http://www.vuw.ac.nz/lals/) was applied to count word types and tokens in both the pharmacology and applied linguistics corpora. The program could also determine which words are found in the most frequent 1,000 words of West's (1953) General Service List (GSL), the second most frequent 1,000 words of the GSL, and the 570-word family Academic Word list (AWL). The four-point rating scale shown below was used to categorize the words in the pharmacology text. Words at Categories 3 and 4 were considered to be technical because all of these words have specialized meanings in the field of pharmacology, whether or not they are also used in general language. After removing technical vocabulary from the lists of general words and the AWL, it was possible to produce lists of words in the following categories: Words found in the first 2,000 word list, those found in the AWL, technical words (C3 and C4 words), and the remainder, low frequency words.

A rating scale for identifying technical words in a pharmacology text

Category 1 (C1) Words with a meaning that has no particular relationship to the field of pharmacology (e.g., *probably, differences, breakfast*).
Category 2 (C2) Words with a meaning minimally related to the field of pharmacology (e.g., *water, body, life*). Such words may be related to the body, or used when describing the actions and effects of drugs, and include terms used in the broader scientific/medical field or hospital environment.
Category 3 (C3) Words with a meaning closely related to the field of pharmacology (e.g., *transmitter, malignant, artery*). These refer to body organs, maladies and medical conditions, the actions and effects of drugs, etc., and are also used in general language.
Category 4 (C4) Words with a meaning specific to the field of pharmacology and not likely to be known in general language (e.g., *stenosis, warfarin, presynaptic*).

The following table of randomly chosen technical words from the pharmacology corpus shows examples of the different categories, together with their frequency of occurrence in the corpus:

A list of randomly chosen pharmacology C3 and C4 words

Typical C3 Words		Typical C4 Words	
	Frequency		Frequency
CELLS	104	HEPATOTOXIC	6
HEART	99	TRINITRATE	6
CHANNELS	79	RIBOSOMES	5
ACTIONS	77	LIPIDS	4
BLOCK	54	OOCYTE	4
FAILURE	51	PALLIDUS	4
INHIBITS	46	VINCRISTINE	4
SYMPATHETIC	40	GONADOTROPHINS	3
LOCAL	39	NORADRENALINE	3
TRANSMITTER	37	FLUCONAZOLE	2
DEPENDENCE	34	METHADONE	2
ELIMINATION	29	SULPHYDRIL	2
NERVOUS	27	ACETYLSALYCLIC	1
WITHDRAWAL	25	BISPROLOL	1
BACTERIA	22	CYCLOPROPANE	1
COMPOUNDS	16	DISOPYRAMIDE	1
FEVER	15	EURYTHROID	1
STIMULATED	10	IONISATION	1
MESSENGERS	7	KETONE	1
RELAXATION	4	POLYPEPTIDE	1

What is most striking is that the C3 words occur on average with a much higher frequency than C4 words, many of which are the names of drugs and are found only once or twice in the corpus. Another observation we can make is that there are two clear subcategories of C3 words: words such as *bacteria, fever*, and *heart*, which are clearly medical terms but are likely to be known by the layperson, and words like *dependence, transmitter*, and *inhibits*, which occur in general language but are used with a technical sense in pharmacology. We might label the former category "lay-technical," and the latter, with their technical meaning in a sense hidden, "cryptotechnical."

These findings lead me to suggest the following categories which do, I believe, more clearly represent the different types of vocabulary found in a specialized text.

Technical Vocabulary

This is the category of vocabulary most obviously associated with specialized texts. It can be further divided into *fully technical vocabulary, cryptotechnical vocabulary,* and *lay-technical vocabulary.*

Fully technical vocabulary comprises those words whose meaning is clearly technical; they are specific to the field and not likely to be known in general language. Examples taken from the pharmacology corpus are *fluconazole, sulphydril*, and *tricyclic antidepressant.* Typically these are the names of drugs, and many are *hapax legomena* — found only once in the corpus. In applied linguistics, they might be words such as *morpheme, phoneme*, or, indeed, *hapax legomena.*

Cryptotechnical vocabulary, as we have seen, consists of polysemous words like *transmitter* and *relaxation* which could be said to be "cryptic" in that they have a hidden technical meaning. Examples from the applied linguistics text are words such as *irregular* (verb), *token*, and *sense.* We have, of course, met such words before — Trimble's subtechnical and Lan's semi-technical vocabulary, for example — but the prefixes "sub" and "semi" imply that this vocabulary is somehow lacking in "technicalness." The fact is that these words, when found in a specialized text, are used in the same way as words which are clearly technical, and it is important that we have a category that shows this.

Lay-technical vocabulary comprises those terms which are obviously technical but are likely to be known by the layperson — words like *bacteria, fever*, and *heart* in pharmacology, and *word, sentence*, and *grammar* in applied linguistics.

Academic Vocabulary

Academic vocabulary consists of the words found in Coxhead's Academic Word List, after removing those words that could be considered technical. Words which are common in a wide variety of academic texts are found in this list — *assume, concept*, and *proportion*, for example. The list contains many of Inman's subtechnical words, Baker's subtechnical/rhetorical words, and discourse-organizing words such as anaphoric nouns.

General Vocabulary

General vocabulary consists of the words remaining after technical and academic words have been extracted. Most of these will be high-frequency words, but we will also find a significant number of words not found in the first 2,000 words or so of a general frequency list such as the GSL or JACET 8000 (2003) list. Important discourse-structuring words (e.g., *problem, findings*) are found in this group as well as in the AWL.

Quantifying the Vocabulary of Specialized Texts

Estimates as to the size, and consequently the importance, of a technical vocabulary vary quite considerably. Nation (2001) has estimated that typically only 5%, or one in twenty words, in a specialized text are technical. Several studies, however, have indicated that technical vocabularies can be much higher than this. Inman (1978), as we have seen, found that 21% of the words in her study were technical; Farrell's (1990) figure of 27.7% was slightly higher. Chung and Nation found that 31.2% of words in an anatomy text were technical, and Fraser's (2005) figure of 35.9% — more than one in three words — for technical vocabulary in a pharmacology text was even higher.

Technical vocabularies, then, may be quite large, particularly in medical disciplines. However, Fraser (*ibid.*) found that many cryptotechnical and lay-technical words come from the most frequent 1,000 words of the GSL (15.5%), the second most frequent 1,000 words (10.6%), and the AWL (12.4%), which means that 38.5% of these words are found in the first three most frequent word lists. Clearly, a sizeable proportion of technical words occur frequently in ordinary English and will therefore be familiar to the non-expert.

Pedagogical Implications

Having looked in some detail at the nature of the lexis in specialized texts, let us now look at some possible implications for teachers and learners in the ESP classroom.

What do teachers need to know?

The different categories of lexis in a specialized text

Specialized texts, as we have discovered, do not simply consist of "technical" and "non-technical" words. The teacher of an ESP course needs to have a thorough understanding of the nature and role of the different categories of words — fully technical words, cryptotechnical words, academic words — which all have their own particular role to play in the overall construction of a text. Teachers have to pay particular attention to cryptotechnical words; the assumption that both they and their students share an understanding of the meaning of a word that looks familiar may not always be warranted.

The learners' subject matter

Given the size and complexity of specialized vocabularies, it seems unlikely that simply having a good knowledge of general English will be sufficient for teachers to teach ESP

effectively. There is some support for this view: Histon (2004), for example, suggests that, for teachers of ESP, a knowledge of the subject content is more important than either they or their students may realize; Bell (1996) believes that at the postgraduate level, in cases where one academic field is common to all the students, a relevant background is all but essential for effective training in the complex academic and language skills required. It is, of course, impossible for all ESP teachers to be specialists in their students' disciplines, but teachers should certainly be prepared to invest a significant amount of time into acquiring subject content knowledge.

The importance of corpora

Teachers should be aware of the potential of corpus analysis in enabling them to make their own specialized investigations. Word lists and concordances can be produced relatively easily using software such as Wordsmith Tools (available from http://www.oup.com/elt/global/isbn/6890/.) Specialized language corpora can be used, for instance, to provide frequency information (helping teachers to decide which words should be taught first), to build glossaries, to identify technical terms and multi-word items, and to determine frequent collocations. Fraser (2002) shows how a frequency count derived from a corpus of medical journal articles can be used to investigate the distribution of different words across the IMRAD (Introduction, Methods, Results, Discussion) structure of articles. Chujo and Utiyama (2004) describe how statistical measures can be applied to a specialized corpus in order to identify multi-level technical vocabulary for pedagogical purposes.

What do learners need?

A large general vocabulary

Many technical words, as we have seen, are found in the lists of most frequent words and are in fact not uncommon in ordinary English. Having a large overall vocabulary will make it much easier for learners to acquire the meanings of polysemous cryptotechnical words, for example, and will mean that they are already familiar with many discourse-structuring words. Laufer (1989) has evidence to suggest that 5,000 words seems to be the lexical threshold beneath which other facilitating factors in reading comprehension may not be very effective. We should try to ensure that students beginning their academic studies have, at the very minimum, reached this level. It is, therefore, important to include techniques and strategies for increasing general vocabulary in an ESP course.

Help with technical words

There have been suggestions that learning technical words is a consequence of studying a particular discipline. However, as Chung and Nation (2003) and Fraser (2005) have shown, technical vocabularies may be very large and cannot therefore be ignored in the classroom. Learners can be helped to cope with both fully technical and cryptotechnical

words, although the type of help required will be quite different.

Learners should be trained in strategies that will help them understand and remember the words. For example, the teacher can take advantage of the fact that a large number of technical words are those of Greek or Latin origin. Students should be encouraged to analyze such words wherever possible and relate the meanings of the word parts to the meaning of the word. In the field of medicine, for example, a knowledge of affixes and stems such as *-itis, haemo-*, and *photo-* will give learners access to many technical words in the field. Chung and Nation (*ibid.*) also give examples of clues in texts that learners need to be familiar with in order to identify technical words: the words being defined in the text, being written in bold or italics, or appearing as a label in a diagram, for example.

For ESP learners in Japan, teachers can take advantage of the fact that some highly specialized words are represented in Japanese by *katakana*. This is particularly apparent in pharmacology, where many names of drugs are similar in both languages — *methadone* is "メタドン (METADON)" in Japanese, for instance, and *vincristine* is "ビンクリスチン (BINKURISUCHIN)." A good number of words, then, may already be "known," but teachers will still need to help their students with pronunciation and spelling, which can be a source of considerable misunderstanding.

We mentioned that techniques which increase the students' general vocabulary knowledge would be useful; the more general words learners are familiar with, the better equipped they will be to guess the meanings of cryptotechnical words. Students can also be helped to see how the high-frequency meanings of words relate to the technical uses. A word of caution, though: it may be that learners will be able to guess the meaning quite easily of *wall* in *cell wall*, for example, but they will almost certainly face problems when they come across a word like *sympathetic* (as in *sympathetic nervous system*). In order to make the learning of cryptotechnical words more systematic, a glossary (serving both as a checklist for the teacher and an index in which both the general and specialized meanings are explained) could be compiled. Lam (2001) found that learners using this kind of specially-prepared glossary performed better than those using regular dictionaries. See Fraser (2003: 41-45) for an example of a glossary of cryptotechnical words prepared from a medical English corpus.

An understanding of the role of discourse-organizing words

In the genre of the scientific research article, in particular, discourse-structuring words have implications for the teaching of both reading and writing skills, and an understanding of how these words operate is vitally important if misinterpretation is to be avoided. Anaphoric nouns, for instance, have the capacity to function as "structural signposts" — words which enable the reader to perceive the framework of the writer's argument more easily. An awareness of how such words can signal the author's attention will help learners to understand the different ways in which the message is being developed.

Instructors face difficulties in teaching discourse-structuring words. It is important

that these important words be taught not in isolation, but in the context of the message. Reading strategies can then be developed which enable the learner to guess unknown words or phrases. Because discourse-oriented items help the reader to interpret large patterns in text, writing tasks given to students should necessarily require them to produce lengthy stretches of work. The best sources of discourse-structuring words are probably the learners' own subject materials coupled with reference materials such as Fraser's (2003: 28) list of frequently occurring anaphoric nouns.

Opportunities and strategies for independent learning

As with general English learners, ESP learners should be encouraged to learn vocabulary independently. More proficient learners may benefit from the development of vocabulary learning strategies — guessing from context, for example. Specialized dictionaries have an important role to play, and learners should be trained in their use. It is important, too, that they are given opportunities to discover facts about the language; one way of doing this is data-driven learning (DDL), in which learners can discover patterns of vocabulary usage, for example, by studying corpus data in the form of concordance lines or sentences.

Conclusion

This paper has provided an overview of some of the research which has been carried out into the nature of ESP vocabulary. Suggestions were offered for alternative categories that more clearly represent the different kinds of technical and sub-technical vocabulary. The characteristics of these different groups of words were examined in some detail, and implications for the teaching and learning of specialized vocabulary were discussed.

The neglect suffered by vocabulary in ESP in the past is all the more surprising since the most serious difficulty identified by the language student is always likely to be "I don't know enough words!" However, researchers now acknowledge that ESP learners need to have an excellent command of a wide range of vocabulary. Those words we identified as "cryptotechnical" seem to be of particular importance, due to their frequency of occurrence and potential to be misunderstood. Future research might usefully look at this category of words in more detail.

Swales (1985: 214) has argued that ESP cannot "come of age" until more efficient ways have been found to cope with the vocabulary problem. This paper has shown that progress is undoubtedly being made; much work, however, still remains to be done on the part of ESP practitioners.

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要　約

ESP（特殊な目的のための英語）教育における語彙の特徴と役割

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近年，学術研究において使用されている専門用語の持つ役割への関心が高まってきている。このため，学術および専門分野で広く使用されている英語を教授していくための，効果的なESP（特殊な目的のための英語）プログラムを開発し，提供していくことは日本の大学レベルの語学教育においても不可欠となる。

本稿では，ESP語彙の特徴に関するいくつかの先行研究の概要を紹介し，専門分野のテキストに見られる様々な術語および準術語を独自の方法で分類している。異なる術語グループの特徴を詳細に調査した結果，最も頻度の高い術語の多くが，実はごく一般的な単語に専門的な意味が「隠れている」（「クリプトテクニカル（cryptotechnical）」として分類）タイプの単語であるという結論に至った。同時に本稿では専門分野の語彙習得に関する教授法の提示も行っている。