An integrated ESP approach to vocabulary teaching in pharmaceutical science

Judy NOGUCHI
(Mukogawa Women's University)

1. Introduction

Anyone trying to buy non-prescription medicine at a drugstore will encounter words like nasal secretion, rhinitis, arthralgia, nasal dilator, and analgesic when reading medicine packages to decide what to buy. If “technical terms” like these are used even in materials for the general public, then imagine what their range and frequency must be in specialist materials to be read by a person training to enter a health-care profession.

Nation (1990: 13-14), commenting on a short technical text for young native speakers, says that “about 87 percent of the words are high-frequency words . . . . The remaining words in the text can be divided into two groups.” One is a group of “technical words” which are needed for a certain topic or subject area and the other is a group of low-frequency words which do not appear very often in English texts but are nevertheless needed to understand even relatively simple texts. As examples of the latter low-frequency words, Nation (1990: 13) gives “dinosaur,” “tentacles,” “squid,” “geologists,” “coiled,” and “preyed” from a text for young native English speakers on ammonites (another low-frequency word). Both these subject-specific and low-frequency words will be referred to as “technical terms” in this paper, and particular attention will be paid to those terms composed of affixes of Greek/Latin origin.

The vocabulary teaching method described here was developed mainly to help students cope with the numerous technical terms with Greek/Latin roots that they would encounter in their study of pharmaceutical science subjects. Many of these terms appear as loanwords in Japanese [cyanosis], [rheumatism], [alkali] but the English word would be difficult to imagine from the Japanese pronunciation. The integrated teaching approach presented shows students how such technical words are formed, tries to make them aware of related sub-technical vocabulary, and also involves them in oral/aural practice to promote active learning.
2. Propensity of Greek/Latin roots in scientific discourse

As to why such Greek/Latin root terms are so commonly found in scientific discourse, White (1998) states that the original reasons were historical—when modern Western experimental science was emerging, classical Greek and Latin scholarship were highly valued. However, it is puzzling why this tradition is maintained even today. White (1998: 287) describes an interesting instance in which tradition won over what would seem a simpler and more rational choice:

This preference (for borrowing from Greek and Latin) can be observed widely throughout the scientific discourse. It is compellingly demonstrated by an example... from an article in Scientific American from December 1996. Many of the categories of the life sciences have both a non-native Greek/Latin derived name and a vernacularly derived name. In this case the term programmed cell death and its equivalent, apoptosis, both refer to the process by which cells die as a natural part of an organism’s life cycle. As generalist, semi-popular journal rather than strictly specialist journal, Scientific American makes some concessions to vernacular discourse and consequently the opening paragraphs use both the vernacular and non-vernacular terms to reference the category, as well as a strictly vernacular, non-specialist equivalent, cell suicide. However, after this initial orientation, the Greek/Latin derived term apoptosis takes precedence and is the only name used for the remainder of the article. Tellingly, therefore, the non-native form is preferred despite the availability of a vernacularly derived, self-explanatory equivalent.

White (1998: 290) goes on to try to explain why this tradition continues, noting that “it is unlikely... that the practice would remain so dominant were it not communicatively functional.” The conclusion reached is that it is the very “morphological and phonological ‘strangeness’ ” of these terms that is used to signal the fact that these technical terms represent a “version of reality which... is ‘alien’ to the version of the reality construed by the familiar, typically native or nativised forms of vernacular discourse.”

Whatever the reason, technical terms composed of Greek/Latin word derivations abound in the life sciences and must be learned by students of these disciplines. Indeed, the students themselves express a need for this. A survey of fourth-year students majoring in pharmaceutical sciences at my university showed that, of ten questions evaluating the English courses they had had during their first and second years, the highest score was given to the usefulness of the affix quizzes that were part of each lesson during their second year. On a scale of 1 to 5 (1 = disagree completely to 5 = strongly agree), the highest score of 3.72 ± 0.80 was given to “the affix quizzes were useful.” In addition, in the free response section of what they thought, in
retrospect, was useful in their first and second year English courses, 52 out of the 173 respondents, or 30.1%, specifically wrote in the value of the affix quizzes.

3. Rationale for teaching technical terms using affix quizzes

This paper describes a vocabulary-focus component of a one-year course in English for second-year pharmaceutical science students at a women’s university. The textbook (Uchimura et al. 1990) has a section on affix terms followed by units of texts which had been selected by university pharmaceutical science instructors as expected to be useful in the students’ future studies.

In considering how to incorporate the teaching of technical terms in the course, the following aims were set:

1. to make students aware of how these affixes are used
2. to help them learn the terms together with the more common sub-technical English words
3. to have them interact with vocabulary for in-depth processing
4. to include oral/aural practice with vocabulary because many terms appear as loanwords in Japanese with different pronunciation.

3.1 Aim 1: Making students aware of affix usage

In a recent book on the description, acquisition and pedagogy related to vocabulary, Schmitt (1997: 202) refers to Nation’s (1994) suggestion that in the case of low-frequency words, students should be taught strategies for dealing with them, including guessing from context and using word parts. With reference to the latter, Nation (1990: 169) states that “to make use of prefixes and roots, learners need three skills. They need to be able to break new words into parts so that the affixes and roots are revealed, they need to know the meanings of the parts, and they need to be able to see a connection between the meaning of the parts and the dictionary meaning of the new word.”

In the first class session, students are introduced to the affix section of the textbook and the use of affixes in familiar everyday words. For example, telling them that the affix tele means far and asking them for words that they know using it usually produces a list including telephone, television, telescope. They are informed that phone refers to sound, vision refers to sight and scope means to see, which makes them quickly realize how useful affix knowledge can be.
3.2 Aim 2: Helping students learn sub-technical terms

The second aim was to encourage the students to learn the affix terms together with the sub-technical terms often appearing in pharmaceutical sciences. In as early as 1965, in *The Structure of Technical English*, which Swales (1985: 18) calls “the first ‘real’ ESP textbook . . . based on a serious and detached investigation into the characteristics of the language found in science and engineering texts,” Herbert states that the “semi-scientific or semi-technical words, which have a whole range of meanings and are frequently used idiomatically,” are much more difficult than the technical words themselves, which usually have a single specific meaning. Herbert (1965) goes on to say that “words such as work and plant and load and feed and force. Words like these look harmless, but they can cause a lot of trouble to the student. And there is another kind of word which is important; the verbs, adjectives and adverbs that are not specifically scientific, but which belong to the phraseology of science.”

Herbert’s comments are echoed by Robinson (1980: 71) who points out that it is “the sub-technical level which is often difficult.” Robinson also presents Fanning’s (1977) suggestion “that it is not single words which are always difficult, but phrases, so that common combinations of words should be taught, not just the individual vocabulary items of discipline.” More recently, Katsuragi (1998) presents a list of sub-technical vocabulary after pointing out the need for such knowledge for English for specific purposes.

With these considerations about sub-technical vocabulary in mind, the affix quizzes were composed of sentences including general vocabulary which was considered necessary for future work in pharmaceutical sciences. For instance, the students need to know common words for parts of the body such as liver, kidney, spinal cord, arteries. They also need to learn commonly used words for diseases such as diabetes, arteriosclerosis, pneumonia and for medical situations, including patient, physician, diagnosis.

The other group of sub-technical vocabulary items, pointed out above as posing serious problems, is composed of general terms which take on special meanings in pharmaceutical sciences. For example, let us consider the words indication and inactive. When the students look up a word in the dictionary, they often simply take the first meaning. However, the first meaning of indication in a general dictionary may not be the one required to understand a pharmaceutical text.

Even the examples given by general dictionaries can be puzzling when technical
definitions are needed.

To deal with this problem of sub-technical vocabulary, the affix quizzes always

<table>
<thead>
<tr>
<th>Word</th>
<th>Dictionary examples</th>
<th>Usage example</th>
</tr>
</thead>
<tbody>
<tr>
<td>indication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>指示、表示、指摘</td>
<td>All the indications are that we are going to receive reasonable support from abroad. . .</td>
<td>Indications and Usage</td>
</tr>
<tr>
<td>inactive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>不活発な、活動しない、怠けている</td>
<td>He certainly was not politically inactive</td>
<td>Inactive Ingredients</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Word</th>
<th>Dictionary examples</th>
<th>Usage example</th>
</tr>
</thead>
<tbody>
<tr>
<td>expression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighthouse</td>
<td>COBUILD</td>
<td>PNAS*</td>
</tr>
<tr>
<td>the expression of ideas</td>
<td></td>
<td>DNA-binding sites for these proteins were required for the hepatocyte-specific expression of two genes expressed at high levels in the liver.</td>
</tr>
<tr>
<td>expression of emotion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a terminal station</td>
<td></td>
<td>Ten independent transgenic lines of tobacco expressing mRNA for the C-terminal domain of the AIMA\textsuperscript{V} P\textsubscript{2} protein</td>
</tr>
<tr>
<td>terminal cancer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>his illness was terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>upstream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;--&gt; downstream</td>
<td></td>
<td>an assay system for the purification of novel participants (both upstream and downstream of Ras) in the pathway(s) regulating MAP kinase</td>
</tr>
<tr>
<td>The water rose high enough for them to continue upstream</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
used the technical terms in sentences which also included commonly used English words and the related sub-technical vocabulary. Here are some examples:

- An **oncologist** is a physician who specializes in the treatment of cancer.
- An **isotonic** solution is a liquid having the same osmotic pressure as the fluid in the human body.
- There are beneficial **enterobacilli** in the intestines which can help digestion.

### 3.3 Aim 3: Encouraging “deep” processing of words

Schmitt and McCarthy (1997: 2-3) point out that one of the recurring themes in their book on vocabulary issues is that the “deeper processing of words enhances their learning . . . .” The more cognitive energy a person expends when manipulating and thinking about a word, the more likely it is that they will be able to recall and use it later. This idea was first formalized as the Depth (or Levels) of Processing Hypothesis (Craik and Lockhart 1972; Craik and Tulving 1975).” Deep processing entails asking students to “manipulate words, relate them to other words and to their own experiences, and then to justify their choices . . . to extend their learning of the world outside of the classroom (Sokmen 1997: 242-243).” Of course, even “shallower” strategies can be effective, with rote repetition being useful if students are accustomed to using it (O’Malley and Chamot; in Schmitt (1997: 201)).

To encourage deep processing of the affix terms, the quizzes required the students to write in the appropriate form of the word with the correct spelling (using a capital letter if it appeared at the beginning of the target sentence, the plural form or a conjugated form if it was used as a verb). Next, the quiz sheets were immediately exchanged with other students in class and the reasons for the choices were elicited in relation to hints in the sentence. If time permitted, students were asked for other words using the affix term under consideration. For example, if **microanalysis** was the optimal choice for the target sentence:

Microanalysis requires only very small amounts of sample.

Then the reason to be elicited from the students was that *micro* means *very small* and *analysis* usually is done with samples. With the focus on *micro*, students could then be asked for other words that they knew using this affix (e.g., *microscope, micrometer, microsome*).

### 3.4 Aim 4: Incorporating oral/aural practice

Johns and Dudley-Evans (1980: 146), in discussing technical vocabulary, point out that although “subject-lecturers often assume that technical terms are familiar to
students,” serious problems can arise from “sound-spelling correspondences.”

Many technical terms are international, and may be used in the student’s first language in the same way as they are used in English. However, the familiar term, while presenting no difficulty on the printed page, may be difficult to recognize when spoken.

This happens very frequently with Japanese students. Daulton (1998), who works at Nanzan University, states that “a third of the most useful words of English” are already familiar to junior high school students in Japan and suggests that this cognate knowledge be used when teaching vocabulary. While being a good idea, this can lead to serious problems with sound-spelling correspondences. For example, *microanalysis* would be pronounced as *mi-ku-ro-a-na-rai-shi-su* and *nephrosis* would be *ne-fu-roo-ze*. To deal with this issue, the students were asked to first read aloud the words in the affix quizzes and then the sentences with understandable pronunciation and stress.

4. **Classroom procedure**

The actual procedure used in class was as follows. The students were given a 10-minute quiz at the beginning of each class session. The classes met for 90 minutes once a week, for about 12 to 13 sessions per semester in a two-semester course for English for pharmaceutical sciences. There were about 55 students per class. The textbook section on Greek and Latin affix terms consisted of about 15 pages with about 20 to 28 affix terms per page. This amounted to three to four new terms to learn a day. After completing this section, review quizzes or those of items based on text units with many affix terms (e.g. drug side effects) were given.

At the end of the 10 minutes, the papers were collected and redistributed for correction by the students. During the first semester, the students discussed the answers in groups, which they had formed voluntarily at the beginning of the semester, and wrote out the sentences on the blackboard with what they thought was the best answer. They were given group points for every contribution whether or not the response was correct. This gave them the freedom to experiment with different responses even if they were not completely certain. What was important here was that they actively discussed the terms and worked with them to promote “deep” processing.

After all the sentences had been written on the board, the groups would volunteer to read out a sentence. If they thought it was correct, they would simply explain the reason for the choice, for example:

The heart attack patient was treated by a team of *cardiologists*. 
If they thought some correction was needed, they would explain it. There was no penalty for an incorrect answer and after a few sessions, the students lost their qualms about making mistakes. In fact, one of the “complaints” was that there was too much competition to volunteer answers!

After the choice had been explained, the entire class was asked to read the sentence in unison with proper pronunciation and intonation. As there are many technical terms which have been incorporated into Japanese, this was particularly important.

After all ten sentences had been checked, individuals were asked to volunteer to read out the sentence with acceptable pronunciation and stress. One point for this went to the person’s group. If the reading was not acceptable, another volunteer would try. The students were eager to try and did not mind if their reading was not considered acceptable. Because they were working for the group, they lost their fear of making mistakes.

In the second semester, the number of sentences was increased to 15 but the time remained the same, 10 minutes. The checking was only done orally, but the reading practice was the same.

The entire procedure took about 30 minutes out of a 90-minute class.

5. Student evaluation of the procedure

Students were asked to respond to a questionnaire about class procedures at the end of the year. One of the statements on the questionnaire was:

接頭語、接尾語のクイズは役に立った
[The affix quizzes were useful.]

1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree;
4 = agree; 5 = strongly agree

(percentage of students)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996 (n = 186)</td>
<td>0.54</td>
<td>6.45</td>
<td>25.27</td>
<td>40.86</td>
<td>26.88</td>
</tr>
<tr>
<td>1997 (n = 196)</td>
<td>0.51</td>
<td>3.06</td>
<td>28.06</td>
<td>38.78</td>
<td>29.59</td>
</tr>
</tbody>
</table>

The total number of students who thought that the affix quizzes were useful amounted to 67.74% for 1996 and 68.37% for 1997.

The questionnaire also had a section in which the students could freely comment.
on anything about the course. In 1996, 34 (18.28%) and in 1997, 30 (15.31%) specifically mentioned the affix quizzes in a positive manner. Sample comments are:

*The quizzes were very (extremely) useful.
*Having the quizzes at every class was very useful.
*Did not like at the quizzes at first but found useful after got used to taking them.

There were no negative comments related to the quizzes in 1997. In 1996, there were four negative comments out of 186 responses:

*There were too many words to study. (2 responses) [The number of pages to study in one week was reduced from 2 to 1 in 1998.]
*More efforts should be made to prevent cheating.
*Want more time for the quiz (the opposite response was also given: the time limit of 10 min. was good).

6. Extended evaluation

In December 1998, a follow-up questionnaire and quiz of fourth-year students (who had not had any required English courses for about a year or more) was conducted. As stated in Section 2, the affix quizzes were very highly rated. The results of the quiz included with the questionnaire offered support for this. All first-, second- and fourth-year students took the same quiz with 20 sentences from recent newspaper and news magazine articles. Examples included:

As hypertension is a leading cause of heart attack and stroke, efforts should be made to keep blood pressure within the normal range.

Archaeological work in Kyushu is revealing new concepts on ancient civilizations in Japan.

A form of arsenic is used in a pesticide to kill termites.

The students were asked to select from a list the technical term (underlined above; appearing as a blank in the quiz) which would best complete the sentence.

ANOVA one-way

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Total</th>
<th>Average</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>First-year students</td>
<td>271</td>
<td>2304</td>
<td>8.50</td>
<td>13.84</td>
</tr>
<tr>
<td>Second-year students</td>
<td>190</td>
<td>2958</td>
<td>15.57</td>
<td>10.53</td>
</tr>
<tr>
<td>Fourth-year students</td>
<td>173</td>
<td>2667</td>
<td>15.42</td>
<td>8.94</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>7592.08</td>
<td>2</td>
<td>3796.04</td>
<td>329.64*</td>
</tr>
<tr>
<td>Within groups</td>
<td>7266.39</td>
<td>631</td>
<td>11.52</td>
<td></td>
</tr>
</tbody>
</table>

*F crit = 3.01, p > 0.05
These results show that both the second- and fourth-year students performed much better than the first-year students who had not yet had exposure to the affix quizzes.

7. Conclusion

This paper has described an integrated approach to helping students acquire the technical and sub-technical terms they need to understand field-specific literature. The approach includes oral/aural and reading/writing components plus strategy training for vocabulary study. The use of quizzes such as these with active in-class interaction should promote the deep processing which seems to enhance vocabulary acquisition.

Acknowledgements

I wish to thank Dr. Kyoko Ishiguro for administering the fourth-year student questionnaires, Sandra Ishikawa for her valuable discussions (any errors are mine), and Emi Iwasaki for help with the data input.

References


Schmitt, Norbert and McCarthy, Michael (eds.) (1997). *Vocabulary: Description, acquisition and
Appendix  Sample affix quiz (This is a review quiz.)
Complete each sentence with the correct form of the most suitable word from the list below.

1. _______ is the study of how to adapt working conditions to the human worker.
2. The doctor used a _______ needle to inject the drugs under the skin.
3. He underwent surgery to remove a _______ in the stomach.
4. _______ refers to a condition of impaired digestion.
5. An _______ disease is an illness which is always present in a certain region.
6. The terrible accident left him a _______ and he could not move his arms or legs.
7. A _______ drug causes the blood vessels to become narrower.
8. The body cells decay and die in _______.
9. The mouse was given an _______ of tissue from another mouse of the same species.
10. _______ can be used to determine the functional capacity of part of the lung.
11. The dentist applied local _______ before pulling out the decayed tooth.
12. A _______ is a physician who specializes in children's diseases.
13. In _______, chemical compounds are formed in living organisms due to enzyme action.
14. A poisonous substance that destroys the nerves is called a _______.
15. If a medicine is _______, that means it should not be used.
<table>
<thead>
<tr>
<th></th>
<th>6</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Class-No.</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>Date</td>
<td>Checker</td>
</tr>
</tbody>
</table>