Vocabulary-Level Assessment for ESP Texts Used in the Field of Industrial Technology

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English classes taught at Nihon University, College of Industrial Technology (CIT) consist of three types: English for General Purposes (EGP), English for Specific Purposes (ESP), and, finally, “semi-ESP” courses, which are meant to supply transition between the EGP and ESP courses. The purpose of this study is 1) to measure, based on the British National Corpus frequency rates, the gradations among vocabulary levels found within EGP, semi-ESP, and ESP teaching materials used at CIT; 2) to measure the degree in percentages to which junior and senior high texts, EGP teaching materials, and semi-ESP textbooks cover vocabulary presented within three different articles used to teach ESP classes; and 3) to identify “bridge-level” materials that more closely connect EGP teaching materials to ESP articles in terms of vocabulary level. The resulting study confirms the existence of a large gap in vocabulary level between the EGP and the ESP teaching materials. The study also reveals that by themselves the texts used in the semi-ESP classes have only a limited efficacy in bridging this gap, but that when supplemented by a specialized ESP vocabulary list they can be more helpful in doing so.

1. INTRODUCTION

1. Background

In order to adequately discuss the content of this study, the authors will first provide some brief background information on Nihon University, College of Industrial Technology (CIT) and the system of English education found within it. CIT is a four-year engineering college which also contains a graduate school offering MA and PhD degrees. The college is divided into seven...
specialized technically oriented engineering departments as well as a Department of Liberal Arts and Basic Sciences. The engineering departments include: Mechanical Engineering, Electrical Engineering, Civil Engineering, Architecture and Architectural Engineering, Applied Molecular Chemistry, Industrial Engineering and Management, and Mathematical Engineering.

English classes taught at CIT consist of three types: English for General Purposes (EGP), English for Specific Purposes (ESP), and, finally, "semi-ESP" courses. EGP courses are taught to freshman and sophomore students and are designed to further the student's abilities in using English as a communicative tool. Standard EFL college level textbooks are used in these courses. ESP courses are taught to seniors and graduate students and are designed to inculcate students with an ability to read and write the technologically oriented English that they are likely to encounter in their professional careers, a set of goals that have been greatly underscored by the rise of English as the recognized international language of Science and Technology. Consequently, technical articles from professional journals are used in lieu of a text. Semi-ESP courses are taught to juniors and are meant to bridge the gap between the types of English used in EGP and ESP classes; or, in other words, to supply transition between EGP and ESP classes. An example of one such textbook used in these classes is *English for Science and Technology: Starting from the Basics*.

However, even though semi-ESP classes were introduced into the curriculum to ease the transition from EGP to ESP courses, problems soon arose. The CIT engineering departments soon began to discover that their students had increasing difficulties in mastering the technologically oriented English materials presented in the classroom. The students seemed not to be making a smooth transition from the EGP to the ESP courses. In a word, the semi-ESP classes appeared not to be adequately preparing the students for the exacting demands put upon them in ESP classes, and thus not allowing the students to attain the twin goals that were set up by the ESP classes: the mastery of the reading and writing of technologically oriented English. Hence, all seven departments quickly found themselves experiencing a yearly increase in the demand for a more lucid and comprehensible English education that would include clearly practical applications to the students' future engineering careers—a situation that has been further intensified by the recent surge in popularity of TOEIC as a means of measuring English ability and the subsequent desire this has engendered in students to achieve success in taking the test as a means of providing a competitive edge in being hired and more rapidly promoted.

After considering the circumstances outlined above, the authors hypothesized that the efficacy of the English now being taught at CIT could probably best be improved, by the selection of semi-ESP course teaching materials that would connect EGP and ESP classes in a more graduated, step-by-step fashion. Although several kinds of semi-ESP textbooks are currently available, previous to this study there existed no work which measured either the vocabulary
levels presented in the textbooks or the efficacy of the vocabulary items selected for them.

Consequently, this study was designed to confirm the above hypothesis by identifying and comparing the vocabulary of representative texts and materials used by students in junior and senior high school (JSH), and EGP, semi-ESP, and ESP classes. As a first step, the vocabulary levels of the ESP articles were compared to those of the other English-language educational materials. Next, the degree to which EGP and semi-ESP textbooks cover the vocabulary presented within three selected ESP articles was measured. Finally, a supplemental word list was created that connects more closely the EGP and semi-ESP textbook vocabulary as a whole to that of the ESP articles.

2. Review of the Literature

Chujo (in press) measured a wide range of vocabulary levels of English texts and materials, using the British National Corpus (BNC)—one of the largest corpus resources in the world with more than 100 million words. Since the BNC reflects present day English usage for speech and publications in the UK (Leech et al., 2001), the vocabulary contained in the levels measured by the study was classified as EGP. Chujo and Hasegawa next created a “BNC High Frequency Word List” (BNC HFWL) by the following steps: 1) downloading the 38,683 unlemmatized words in the BNC which occur 100 times or more from Adam Kilgarriff’s Web page (http://www.itri.brighton.ac.uk/~Adam.Kilgarriff/); 2) excluding proper nouns and numerals to ensure its suitability as a criterion list; 3) lemmatizing the words into base word categories; 4) listing each part of speech form under the same base word (for example, ‘answer’ [noun] and ‘answer’ [verb] would appear only once under the base word ‘answer’; and, 5) changing British spellings to American spellings. Using this newly created BNC HFWL, the author then defined the “comprehension coverage” level for the targeted textbook vocabulary, setting it at 95 percent. The researchers chose the 95 percent level as the target for two reasons: first, because Nation (2001) emphasizes that “learners would need at least a 95 percent coverage of the running words in the input in order to gain reasonable comprehension and to have reasonable success at guessing from context”(p. 114); and, second, because the threshold vocabulary required to comprehend a given text is approximately equal to a 95 percent coverage (Finnocchiaro, 1964; Laufer, 1989, 1992). In other words, in order for a reader to understand a text, he or she should be able to recognize 95 percent of the vocabulary, or, to put it another way, to recognize nineteen out of every twenty words. In comparing the BNC HFWL to the English language materials, the researchers, starting from the top of the list, counted how many words would be needed to achieve 95 percent ‘coverage’ of the targeted texts.

Another way to assess the vocabulary level of a targeted text is to calculate the percentage of
increase in the amount of vocabulary learned at each stage by the students as they advance from
the JSH texts toward the targeted text. For example, we can calculate the extent to which the
vocabulary in JSH textbooks (considered EGP) matches with the vocabulary of the targeted text.
We can then assume that the words that match the JSH vocabulary were studied by learners and
are known by them. Chujo and Takefuta (1993) investigated the word matches between JSH
vocabulary and other educational materials in order to obtain an estimate of the percentage of the
amount of vocabulary learned by students at each stage as they advanced from junior high school
toward senior high school. Their study resulted in discovering that the JSH textbook vocabulary was
insufficient for practical language activities.

In another study, Sutarsyah, Kennedy, and Nation (1994) analyzed an economics text
(considered to be a representative ESP text) and found that a group of 34 selected content words
accounted for about 12% of the running words in the text. This study indicates that a small
number of words closely related to the topic of an ESP text are likely to occur with very high
frequency within that text. In the same vein, Farrell’s study (as cited in Nation, 2001, pp.
201-203), created a list of technical vocabulary for the field of electronics from a corpus of
about 20,000 words—the resulting list of highly topic related words accounted for at least 10% of
the running words in the corpus. Thus, Farrell’s study reiterates the fact that words related to
an ESP text’s topic are likely to occur at a very high rate of frequency within that text. We can
conclude, then, that in each ESP text its-own specialized topic vocabulary is used at a very high
rate of frequency in order to convey the unique message of the text.

Summing up the results of these studies, we can draw the following conclusions. Firstly, there
are two means by which to assess the vocabulary level of a targeted text. Method number one
uses a lemmatized “British National Corpus High Frequency Word List” (BNC HFWL) as a
criterion, calculating the list’s coverage over the targeted text. Method number two calculates the
percentage of increase in the amount of vocabulary learned at each educational stage by the
students as they advance from a lower to a higher level. Secondly, the overriding characteristic
of the ESP text vocabulary found in specialized English texts is that it is constituted of a unique
set of words which are, in turn, used at a very high rate of frequency in order to convey the
specific message of the text.

II. PURPOSE OF THE STUDY

The purpose of this study, then, is to 1) use the BNCHFWL to measure the graduations among
vocabulary levels found within JSH, EGP, semi-ESP, and ESP teaching materials, as well as
other English-language materials; 2) to measure the degree in percentages to which JSH texts,
EGP texts and materials, and semi-ESP textbooks cover vocabulary presented within three selected ESP articles; and 3) to identify "bridge-level" materials that connect more closely EGP textbooks and other educational resources to ESP articles in terms of vocabulary level.

III. PROCEDURE

First, samples of ESP articles and a semi-ESP textbook and a variety of English language materials were collected. Second, word lists were created and vocabulary levels were assessed. Next, the rate of vocabulary coverage provided by the teaching materials (vis-à-vis the ESP articles) was identified. A specialized ESP word list was created; and finally, the efficacy of this list was examined. Each step is outlined below.

1. Educational and General-Use English-Language Materials

The authors first collected articles used to teach engineering English to CIT seniors and graduate students from three different engineering areas within the field of industrial technology—from Electrical Engineering, from Applied Molecular Chemistry, and from Civil Engineering. Table 1 shows the titles of the three ESP articles selected from the three engineering areas, the tokens (total number of words) and the types (number of different words) which appear in each of the selected texts.

<table>
<thead>
<tr>
<th>Area</th>
<th>Articles</th>
<th>Tokens</th>
<th>Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Engineering</td>
<td>Laser Based and Air Coupled Ultrasound as Noncontact and Remote Techniques for Testing of Railroad Tracks</td>
<td>5,002</td>
<td>848</td>
</tr>
<tr>
<td>Applied Molecular Chemistry</td>
<td>The Measurement and Meaning of Void Volumes in Reversed-phase Liquid Chromatography</td>
<td>7,335</td>
<td>925</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>Stresses within a Soil Mass</td>
<td>5,110</td>
<td>679</td>
</tr>
</tbody>
</table>

The authors also collected EGP texts and materials and one semi-ESP textbook, as well as JSH textbooks from which college students learned English before entering the university. All of these English-language teaching materials are shown in Table 2, along with their general grade level, English-class category, and number of tokens and types.

Additionally, in order to compare ESP vocabulary level with the vocabulary level necessary
to engage in everyday, practical language activities, the authors collected English transcripts from *TIME*, from *Japan Times* newspaper, from CNN News, and from such tests as TOEIC and TOEFL (Table 3).

### TABLE 2
Other English-Language Educational Materials

<table>
<thead>
<tr>
<th>Grade</th>
<th>Category</th>
<th>Teaching Materials</th>
<th>Tokens</th>
<th>Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior &amp; Senior High School</td>
<td>N / A</td>
<td>Horizon, Powwow series</td>
<td>34,026</td>
<td>2,443</td>
</tr>
<tr>
<td>College Freshman</td>
<td>EGP</td>
<td>First Listening, Introduction to College Life (CALL materials)</td>
<td>64,65</td>
<td>1,122</td>
</tr>
<tr>
<td>College Sophomore</td>
<td>EGP</td>
<td>American Ideas in Japan, Wonderful USA</td>
<td>12,644</td>
<td>1,670</td>
</tr>
<tr>
<td>College Junior</td>
<td>Semi-ESP</td>
<td>English for Science and Technology: Starting from the Basics</td>
<td>12,907</td>
<td>2,171</td>
</tr>
</tbody>
</table>

### TABLE 3
General-Use English-Language Materials

<table>
<thead>
<tr>
<th>Medium</th>
<th>Tokens</th>
<th>Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME</td>
<td>9,202</td>
<td>2,228</td>
</tr>
<tr>
<td>Japan Times</td>
<td>9,262</td>
<td>1,940</td>
</tr>
<tr>
<td>CNN News</td>
<td>9,035</td>
<td>1,766</td>
</tr>
<tr>
<td>TOEIC</td>
<td>7,642</td>
<td>1,411</td>
</tr>
<tr>
<td>TOEFL</td>
<td>7,174</td>
<td>1,464</td>
</tr>
</tbody>
</table>

All of the collected data was processed by the use of two computer programs. The first, developed by the Institute for Computational Linguistics at the University of Stuttgart, was a TreeTagger program which annotated text with part-of-speech and lemma information. The second, software programs developed by Takahashi (1999) and Takefuta (1986), compared the words in one text with those in another text or list. All materials were lemmatized; i.e., for each item selected all inflected word forms having the same stem were listed under a base form and alphabetized with frequency of occurrence information. Proper nouns and numerals were excluded from each set of materials, for “they are of high frequency in particular texts but not in others, … and they could not be sensibly pre-taught because their use in the text reveals their meaning” (Nation, 2001, pp. 19-20).

2. Assessing Vocabulary Level within the Selected Texts

The authors next assessed the vocabulary level of each text or transcript by comparing it with
the BNC HFWL (discussed earlier), which was used as a criterion for this research. Each targeted text or transcript's vocabulary level was defined in the following terms: namely, by identifying and quantifying the number of words from the BNC HFWL that equaled 95 percent coverage of that text. Thus, the BNC HFWL was used to calibrate the graduations among the diverse vocabulary levels contained within the ESP articles, the EGP and semi-ESP teaching materials, and the other English language materials.

3. Vocabulary Matches Between ESP Articles and Other Teaching Materials

Next, the authors calculated the extent to which the vocabulary in JSH texts, EGP texts and materials, and the semi-ESP text match the vocabulary used in the ESP articles. Word matches between the ESP articles and the other materials used in the above comparisons were determined in order to obtain a good estimate of the percentage of increase in the amount of vocabulary learned at each stage by the students as they advanced from the JSH texts toward the ESP articles.

4. Creating an ESP Vocabulary List

In the next step, the authors created an ESP vocabulary list which followed the two criteria of providing reasonable frequency of occurrence and encompassing a wide range (Nation, 2001). In order to create this list, the authors first subtracted the JSH textbook vocabulary from the vocabulary of the ESP articles and then arranged the remaining words in order of frequency, thus obtaining the high-frequency ESP vocabulary items. Words on this list with a frequency of occurrence less than four were then excluded. From the 289 remaining high frequency words, those appearing in only one article were deleted. The resulting list contained 138 words (see Appendix I).

5. Measuring Increase in Coverage of ESP Article Vocabulary

Finally, the authors combined the ESP vocabulary list with the normal semi-ESP textbook in order to determine the percentage of increase in known ESP-article vocabulary that students might reasonably be expected to obtain in this case.
IV. RESULT AND DISCUSSION

1. Graduation of Vocabulary Levels among ESP Articles and Other English Language Materials

First, the authors measured the overall vocabulary level of diverse educational materials by using the BNC HFWL as a scale. The result of measuring the vocabulary levels of the ESP articles and of the other educational and general-use English-language materials is shown in Figure 1. The vertical bars on the graph indicate the number of words from the BNC HFWL which are needed to cover 95% of each category of educational or general-use material selected by the authors. For example, in the TOEIC tests, 3,950 words from the BNC HFWL are required in order to comprehend 95 percent of the words used in the tests. The levels of three ESP articles and four EGP materials were averaged together for exhibition on the graph.

**FIGURE 1**
Vocabulary Levels Measured by the BNC High Frequency Word List

After looking at the graph in Figure 1, we can see that the graduation of vocabulary levels among each category of educational materials appears as one might expect. The JSH textbook level is the lowest, increasing gradually to the EGP text level, and finally rising sharply to the higher levels of the other language materials. It can be seen that the ESP article vocabulary level is much higher than that of TIME, which many educators consider the highest target to be reached by learners of English as a foreign language. The graph in Figure 1 also shows that there
is a big gap in terms of vocabulary level between the EGP teaching materials and the
general-use English-language materials and ESP articles. Such a result indicates that an increase
in the difficulty of EGP teaching materials might be needed. From Figure 1 we can see
additionally that the vocabulary level of the semi-ESP text is located between that of the EGP
and ESP materials. This means that the semi-ESP text is working as a bridge to the ESP articles,
but that there is still far too large a gap between the EGP materials and the ESP articles. Or, in
other words, the bridge is too short.

Additionally, the graph shows that a knowledge of the 11,500 most frequently occurring
words in the BNC is needed in order to gain 95% coverage of the ESP articles
investigated—this is the highest level of knowledge of frequently occurring words required by
any category of educational or general-use material appearing on the chart.

As Nation (2001) stated, “one person’s technical vocabulary is another person’s low
frequency word.” Thus, although the technical vocabulary of the ESP articles is important to
students and teachers whose major area of concern is industrial technology, it is not important in
relation to others, or, for that matter, to the normal vocabulary usage represented by the BNC.
From those two points of view, it is just a collection of low-frequency words. In terms of
everyday usage, then, knowledge of a tremendous amount of words is needed to gain 95%
coverage of the ESP articles. This is what accounts for the vocabulary level of the ESP articles
being measured so high.

<table>
<thead>
<tr>
<th>TABLE 4</th>
<th>Examples of High Frequency ESP Vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESP 1</strong></td>
<td><strong>Electrical Engineering</strong></td>
</tr>
<tr>
<td>86</td>
<td>LASER</td>
</tr>
<tr>
<td>40</td>
<td>FREQUENCY</td>
</tr>
<tr>
<td>39</td>
<td>SIGNAL</td>
</tr>
<tr>
<td>37</td>
<td>PULSE</td>
</tr>
<tr>
<td>37</td>
<td>ULTRASOUND</td>
</tr>
<tr>
<td>28</td>
<td>DENSITY</td>
</tr>
<tr>
<td>28</td>
<td>LONGITUDINAL</td>
</tr>
<tr>
<td>26</td>
<td>FIGURE</td>
</tr>
<tr>
<td>25</td>
<td>GENERATE</td>
</tr>
<tr>
<td>23</td>
<td>FIG</td>
</tr>
<tr>
<td>23</td>
<td>ULTRASONIC</td>
</tr>
<tr>
<td>20</td>
<td>DETECT</td>
</tr>
<tr>
<td>20</td>
<td>TECHNIQUE</td>
</tr>
<tr>
<td>19</td>
<td>DETECTION</td>
</tr>
<tr>
<td>17</td>
<td>ABLATION</td>
</tr>
</tbody>
</table>
Excluding JSH vocabulary, the words listed in frequency order in Table 4 are the 15 highest frequency words used in each ESP article. Numbers in the column to the left of each word indicate rate of frequency; e.g., the higher the number, the higher the rate. The authors found that on average these 15 words make up 10.6% of the running words of the vocabulary of each ESP article. Similarly, Sutarsyah, Kennedy, and Nation (1994) found that 34 content words made up about 12% of the running words of an economic text. Such facts suggest that these specialized vocabularies should be taught in the same manner as are high-frequency words in regular teaching materials—here may lie the key to bridging the large gap in vocabulary between semi-ESP and ESP articles.

2. Insufficient Preparation for ESP Vocabulary Comprehension

Next, beginning with JSH and ending with ESP, the authors grouped the representative educational materials into categories, adding each successive grade level to the former category. For example, the first category was JSH texts; the next, JSH texts plus EGP. The authors then calculated the increase in text coverage as it rose with the addition of each subsequent category. The results are displayed in Figure 2. The titles of the categories of educational materials that were grouped together at each stage are shown in ascending order on the left-hand side of the bar graph. The bar graph itself shows to what percent each category of grouped educational materials covers ESP article vocabulary. The figures on the graph (i.e., 71.3, 73.4, etc.) represent coverage figures for three ESP articles averaged together—in other words, they are composite numbers.

**FIGURE 2**

Percentage of ESP Article Vocabulary Covered by Categories of Grouped Educational Materials

<table>
<thead>
<tr>
<th>Category</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior &amp; Senior High (JSH) Texts</td>
<td>71.3</td>
</tr>
<tr>
<td>JSH + EGP (Freshman) Materials</td>
<td>73.4</td>
</tr>
<tr>
<td>JSH + EGP (Freshman+Sophomore) Materials</td>
<td>77.7</td>
</tr>
<tr>
<td>JSH + EGP + Semi-ESP Text</td>
<td>85.1</td>
</tr>
</tbody>
</table>

The graph shows that knowledge of JSH textbook vocabulary is insufficient for reading the
ESP articles analyzed. The level remains insufficient even if students master EGP textbooks and other materials. Counter to the authors' initial expectation, the semi-ESP textbook did not adequately bridge the gap between EGP and ESP materials.¹

The figure of 85.1% coverage means that there is one unknown word in every 6.7 running words. Such a ratio of known to unknown words would lead to a daunting amount of dictionary work and would mean, in effect, that a student had not reached a level of knowledge that would allow comprehension of the text.

3. Efficacy of ESP Vocabulary List

Finally, the authors discovered that the addition of the specialized ESP vocabulary list created according to the criteria of range and frequency led to a marked improvement in vocabulary coverage of ESP articles. As Figure 3 shows, adding the specialized vocabulary list to the normal teaching materials changes the coverage of ESP article vocabulary from 85.1% to 89.5%.²

Although use of the ESP Vocabulary List does not boost coverage to the 95% level, this data does suggest that one way to solve the problem of inadequate semi-ESP transitional courses is to approach it from the standpoint of vocabulary. As shown previously in Table 4, the topics covered by the three ESP articles examined by the authors come from considerably different fields, though all were selected from departments falling under the domain of the College of Industrial Technology. Nevertheless, because each article was composed of vocabulary considerably different from the others, it would most likely be necessary to prepare a specialized ESP word list for each field or area in order to elevate the coverage to the 95% level. For now, however, that will remain a topic for future study.

¹ In the initial study, the authors examined another semi-ESP text which was published in 2000. The estimation of text coverage percentage derived by adding this semi-ESP text to the EGP text remained very low, equaling only 80.8%, as compared to the 85.1% coverage provided by the other semi-ESP text mentioned in this paper. The text examined in the initial study was selected for use in the semi-ESP classes and was meant to bridge the gap in vocabulary that exists between the materials used in the EGP and ESP classes. It has only a limited efficacy in doing so. It may be concluded, then, that different semi-ESP texts vary in the degree to which they are able to cover the vocabulary used in the ESP articles. To put it another way, each semi-ESP text offers, in effect, either a longer or a shorter bridge. Consequently, great care must be taken to select the semi-ESP text that is able to supply the most extended coverage, or, in other words, the one which provides the "longest bridge."

² For reference, the cumulative number of types, the number of newly introduced words, the percent of ESP article coverage, and the increase in ESP coverage for each category of grouped educational materials are displayed in Appendix 2.
V. CONCLUSION

The resulting study confirms the existence of a large gap in vocabulary level between the EGP teaching materials and the ESP articles used at CIT. The study also reveals that the texts used in the semi-ESP classes that were meant to bridge this gap have only a limited efficacy in doing so. Finally, the authors discovered that the gap in vocabulary level existing between EGP teaching materials and ESP articles could be further reduced by supplementing the semi-ESP texts with a specialized ESP vocabulary list created according to the criteria of range and frequency.

It might be argued, however, that vocabulary is only one aspect from which the overall "meaning" of a text is constituted. And this is quite true—of course, there are others: syntax, grammar, and semantic structure, for example. But, be that as it may, the learning of vocabulary is such a fundamental component of language acquisition that when it is inadequately pursued the ability to understand a text sufficiently becomes next to impossible. Proper grammar can be frequently dispensed with and syntax misplaced, yet, nevertheless, meaning will still, as often as not, be communicated. But lack of vocabulary, the occurrence of an unknown word in a text, is much like a blank spot on the canvas of a painting—too many blank spaces in key areas will result in the object or subject of the painting becoming impossible to apprehend.

In other words, the authors of this paper, to borrow terms from the field of logic, believe that vocabulary is a necessary, if not a sufficient, condition for allowing the comprehension of a text or utterance. To put it another way, vocabulary alone may not guarantee understanding, but the lack of adequate knowledge of vocabulary will guarantee failure. As Sutarsyah, Kennedy, and
Nation (1994, p. 49) have said, "Vocabulary is only one component of a course, but it is a component that learners notice and that can occupy a lot of their learning time." And with good reason—in a technologically oriented text especially, it is extremely difficult to "guess a word in context" when too many of the high-frequency words that constitute the unique set of vocabulary items allowing understanding of that text's specific message remain unlearned.

This leads to another point. Even though students might master the curriculum presented in a semi-ESP course, this fact alone does not automatically mean that the course has been successful. As noted above, if the vocabulary items learned in semi-ESP courses do not represent adequate coverage of the vocabulary utilized in the articles used in ESP courses (for the purposes of this paper, 95%), then the students will, in all likelihood, fail to grasp the fundamental concepts presented within these articles, and thus also fail in the twin goals of the ESP classes: namely, the mastery of the reading and writing of technologically oriented English. As pointed out in the introduction above, this negative result, in fact, has been the experience of CIT when teaching ESP classes. Consequently, the authors firmly believe that adequate vocabulary coverage of ESP texts should be a carefully considered prerequisite in the design of semi-ESP curriculum; and, furthermore, that this study does provide some valuable insights on how to effectively bridge any gaps in vocabulary coverage that might occur between varying levels of English classes, from JHS and EGP to semi-ESP and ESP.

It should be noted, however, that this study needs to be expanded in the future by collecting more ESP articles from the three engineering areas already examined, as well as from the other four engineering areas not yet investigated. It will also be necessary to create a larger ESP specialized vocabulary list. In this way, the authors can confirm their finding that the ESP specialized vocabulary list might be an effective supplementary tool in bridging the gap between EGP and ESP courses. Once this is accomplished, the ESP specialized list can be integrated with a set of vocabulary software already created by the authors (Chujo et al., 2002). Such a step will provide the students with expanded opportunities for vocabulary acquisition and practice as well as prepare them to complete more successfully their ESP coursework.

REFERENCES

Chujo, K. (in press). Measuring vocabulary levels of English textbooks and tests using a BNC lemmatised high frequency word list.

Technology, Nihon University, 35, 11-23.
APPENDIX A
ESP Vocabulary List

This appendix contains the 138 words in the ESP vocabulary list. The number beside each word indicates the rate of frequency of occurrence within the three ESP articles.

6 ACCESS  26 DETECTION  10 LINEAR  12 RATIO
12 ACCURATE  12 DETECTOR  4 LINEARLY  4 RELIABLE
5 ACTUAL  4 DEVICE  9 LIQUID  9 RESEARCHER
12 ADDITION  8 DISCONTINUITY  51 LOAD  5 RESPECTIVELY
5 ADDITIONAL  4 DISRUPT  13 MAGNITUDE  4 REVIEW
4 ADDITIONALLY  12 DISTRIBUTION  7 MAJOR  11 SAMPLE
4 ADEQUATE  5 DOMINANT  21 MATERIAL  4 SCATTER
5 AGREEMENT  22 DUE  12 MAXIMUM  6 SCHEME
16 ANALYSIS  14 ELASTIC  18 MEASUREMENT  4 SENSITIVE
15 APPLICATION  4 EMPLOY  10 MECHANISM  25 SHEAR
8 ASSOCIATE  7 ENGINEER  4 MINIMIZE  40 SIGNAL
14 ASSUME  12 EQUATION  17 MINOR  4 SIGNIFICANT
5 ASSUMPTION  4 ERROR  9 MODE  6 SLIGHT
9 AVAILABLE  7 ESTIMATE  4 NECESSARILY  5 SLIGHTLY
5 AVOID  4 EVALUATE  10 NECESSARY  35 SOLUTION
9 AXIS  5 EXCEED  5 NEGATIVE  10 SPECIMEN
8 BOUNDARY  18 EXPERIMENTAL  4 NONDESTRUCTIVE  271 STRESS
10 COEFFICIENT  4 EXPERIMENTALLY  24 NORMAL  6 SUCCESSIVE
22 COMPARE  12 FACTOR  9 OBSERVE  18 SUGGEST
6 COMPARISON  61 FIG  23 OBTAIN  5 SUITABLE
4 COMPLICATE  36 FIGURE  5 ORIENTATION  32 SYSTEM
38 COMPONENT  41 FREQUENCY  8 PAIR  30 TECHNIQUE
4 COMPOSE  4 FREQUENTLY  12 PARALLEL  6 THEORETICAL
10 COMPOSITION  9 FUNCTION  4 PARAMETER  4 THERMAL
11 CONCEPT  7 HENCE  16 PARTICLE  9 TRANSMIT
21 CONSTANT  4 HOMOGENEOUS  25 PATH  4 TYPICAL
10 CORRESPOND  33 HORIZONTAL  103 PHASE  21 UNIT
8 CURVE  6 ILLUSTRATE  4 PHENOMENON  7 VARIATION
14 DEFINITION  9 INDICATE  17 PORE  14 VARY
5 DENOTE  8 INDUCT  6 PORTION  6 VELOCITY
33 DENSITY  13 INITIAL  8 PROCEDURE  139 VOLUME
6 DEPENDENT  4 INTERCEPT  6 PROCESS  5 WAVELENGTH
10 DEPICT  4 INVOLVE  8 PROPERTY  6 ZERO
30 DEPTH  5 ISOTROPIC  5 QUANTITY
27 DETECT  7 LENGTH  11 RANGE
APPENDIX B
The Cumulative Number of Types, Etc.

It should be noted that 83 out of the 138 words on the ESP vocabulary list already appeared in the EGP and semi-ESG texts, thus leaving us with a total of 55 new words. However, the fact that these 83 words are repeated when the ESP vocabulary list is added to the other materials is entirely beneficial: students tend to forget words so such a review provides effective reinforcement. Also, since some of the repeated technical words are used with meanings different from those common to regular usage, learners are assisted in comprehending both the differences and the connections existing between the two sets of meaning.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Cumulative Number of Types</th>
<th>Newly Introduced Words</th>
<th>ESP Article Coverage (%)</th>
<th>Increase ESP Coverage (point)</th>
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<tbody>
<tr>
<td>Junior &amp; Senior High (JSH)</td>
<td>2,443</td>
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<td>71.3</td>
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<td>Texts</td>
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<tr>
<td>JSH + EGP (Freshman)</td>
<td>2,766</td>
<td>323</td>
<td>73.4</td>
<td>2.1</td>
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<td>Materials</td>
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<td></td>
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<tr>
<td>JSH + EGP (Freshman +</td>
<td>6,652</td>
<td>586</td>
<td>77.7</td>
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<tr>
<td>Sophomore) Materials</td>
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<tr>
<td>JSH + EGP + Semi-Esp Text</td>
<td>4,273</td>
<td>921</td>
<td>85.1</td>
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</tr>
<tr>
<td>JSH + EGP + Semi-Esp Text +</td>
<td>4,328</td>
<td>55</td>
<td>89.5</td>
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<td>ESP Voc. List</td>
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Applicable levels: college, adult
Key words: ESP, vocabulary level, semi-ESP, EGP

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