Chapter 3

Research Methodology

3.0 Introduction

This chapter presents the research questions addressed in the study and the different stages of research.

It is stated in the literature that learners can improve their vocabulary levels through instruction and also through incidental exposure. So, the present research aimed at assessing the relative effectiveness of both instruction and acquisition. As engineering students need a good knowledge of vocabulary for their future endeavours, it was decided to collect data from engineering students. As many private engineering colleges are affiliated to JNTU, it was thought appropriate to select those colleges which are under JNTU. One more reason was that JNTU has colleges affiliated to it across the state. Hence, data could be collected from students in different districts. As the research wanted to assess the effectiveness of both instruction and acquisition, it was decided to collect data from the first year students of engineering because English is prescribed as a course of study only in the first year. It was also decided to conduct a pre-test at the time of admission and a post-test at the end of the course. A comparison of the two tests threw light on the acquisition of vocabulary by the students.
3.1 The Research Questions

The research wanted to explore whether

- Learners can acquire and use words from their subject textbooks as a result of repeated exposure to the textbooks.
- Explicit vocabulary instruction provided through English textbook can help learners in vocabulary development.
- Extensive reading can help learners in the effective use of vocabulary.

To assess the effectiveness of instruction, it was decided to take 150 target words that appear both in the English textbooks and the engineering textbooks. To assess the students’ ability to acquire words without any instructional aid, it was decided to take 150 target words that appear in the engineering textbooks alone. To understand the student’s existing knowledge of the target words at the time they start their course, a pre-test was administered. The post-test was administered at the end of the course.

A student information sheet (Appendix C) was given to the students both at the time of the pre-test and the post-test. In addition to the other questions like the student’s name, college etc., students were also asked whether they read anything other than the prescribed course material. This piece of information was extracted to understand the effect of extensive reading on vocabulary development.
3.2 Stages of Research

The research was conducted through different stages including the administration of two pilot tests and the main study. The different stages are discussed in the following sections.

3.2.1 Identifying the branch

All the engineering colleges offer instruction in many branches like Civil Engineering, Chemical Engineering, Mechanical Engineering, Computer Science and Engineering, Electronics and Communication Engineering, Electrical and Electronics Engineering etc. Of these branches, Computer Science and Engineering (CSE) and Electronics and Communication Engineering (ECE) are very popular because of the number of career opportunities these two branches provide. Almost every college provides instruction in these two branches.

The prescribed text books for these two branches were gone through carefully with regard to the nature of general vocabulary used. The vocabulary in the text books of CSE is easier than the vocabulary used in the textbooks of ECE. The number of general words is also more in the textbooks of ECE. So, it was decided to collect data from the students of I.B.Tech, ECE.
3.2.2 Selection of Textbooks

First year ECE students have seven subjects to study. They are – English, Mathematics, Mathematical Methods, Applied Physics, C & Data Structures, Network Analysis and Electronic Devices and Circuits.

In addition to English textbooks, some other subject textbooks were also to be selected for assessing the learners’ ability to acquire words. So, all the subject textbooks were gone through with respect to the vocabulary employed. Mathematics and Mathematical Methods were not selected because these books contain more figures than words. C & Data Structures was not selected because it has more number of programmes than theoretical discussions. If a textbook does not explain much theory, only a limited amount of vocabulary is used.

The textbooks prescribed for Applied Physics, Network Analysis and Electronic Devices and Circuits were finally selected for two reasons: all these three textbooks have theoretical explanations which results in considerable use of general vocabulary; all these three subjects are related to one another.

The three textbooks are:

3.2.3 Selection of Target Vocabulary

All the five text books – two English text books and three subject text books – were gone through carefully. Every content word was noted down separately for each subject. These lists were carefully analyzed by the research scholar, two other English teachers and two students who were not part of the research sample, to select the target words. Then two lists were prepared. List 1- Only Engineering (OE)- consisted of 150 words that appeared only in the subject text books. List 2 – English and Engineering (EE) - had 150 words that appeared both in the subject text books and the English text books. On the whole, 300 target words were selected to assess the intentional and incidental learning processes.

3.2.4 Development of Test Papers

As the research wanted to assess the rate of increase in the knowledge of the students as a result of instruction provided through the prescribed English textbooks, and acquisition facilitated through repeated encounters with the engineering textbooks, it was decided to develop a test and administer it to the students. As mentioned earlier there were 300 target words. Developing one test paper using all the 300 words was not considered practical. So, it was decided to develop 10 of test papers; each having 30 target words. Each set of paper would have the same item types.
3.2.5 Pilot study 1

To determine whether the developed test paper was able to assess what it wanted to assess, a pilot test (Appendix D) was administered. Initially, one test paper was developed with 5 subtests using 30 target words. This test paper was administered to 20 students from a class of 60 students. 50 minutes were given to the students to answer the test paper. But, after all the other students had given back their papers, one student gave back the paper saying he was not interested. As a result, responses of 19 students were collected. After correcting the papers, the reliability estimate and construct validity (see 3.5 for the formulae used) were calculated and these were not very encouraging. Reliability is generally estimated to see how reliable the test scores are. Construct validity is calculated to see whether the test items are valid by correlating each subtest with the total test. The reliability estimate was calculated to be 0.57 and the construct validity for the 5 item types was calculated by correlating each subtest with the total test and the result was given here. If the reliability of a test is estimated above .60, then the test is reliable and the validity of the construct generally falls between -1 and +1. The nearer it is to +1, the better correlation each subtest has with the total test.

Correlations of each subtest with the total test and the result are given here.

<table>
<thead>
<tr>
<th>Subtest</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I subtest</td>
<td>0.272</td>
</tr>
<tr>
<td>II subtest</td>
<td>0.79</td>
</tr>
<tr>
<td>III subtest</td>
<td>0.214</td>
</tr>
<tr>
<td>IV subtest</td>
<td>0.87</td>
</tr>
<tr>
<td>V subtest</td>
<td>0.70</td>
</tr>
</tbody>
</table>
The reliability of the test is estimated to be 0.57 which means that the test needs some modification. A test cannot be reliable without being valid. So, construct validity affects the reliability of the test. Here, it is understood that two test items (subtest 1 and subtest 3) were not proved valid, thereby affecting the reliability of the test.

It was understood that the test paper needed modification. Low correlation of two subtests with the total test was the indicator that students did not feel comfortable with two item types. It was also understood that the test paper should have contained more than 30 items because all the 19 students gave back the scripts in less than 30 minutes even though 50 minutes of time was given to them. As one period is for 50 minutes, it was thought convenient to administer the test for a full period. Before conducting a second pilot study, some changes were made in the item types.

3.2.6 Selection of Item Types

It was decided to include five item types in every test paper. In pilot study 1 students did not feel comfortable with two options. As word knowledge is incremental in nature it was thought to be appropriate to start with an item type that was purely receptive and end with an item type that is purely productive. These five item types were: a) word recognition, b) matching words with their meanings, c) finding the relation between words in pairs, d) fill in the blanks and e) using the target words in own sentences. The following sections discuss the reason for selecting these item types.
Word Recognition

Recognition of a word is the first step in the learning process towards attaining a complete mastery of the word. Learning vocabulary, either deliberately or incidentally, does not happen without first recognizing the target word. If the target word is encountered in a meaningful situation, then the word is recognized. In due course of action, based on the nature and quality of the subsequent encounters with the word in question, meaning, use of the word, derivations of the word etc. are learnt. If a word is not recognized in the input material, there will be no question of learning that word. So, as word recognition is the first step towards learning a word, the first item type was to recognize the target words which appeared in the textbooks.

Matching words with their meanings

After a word is recognized the next meaningful encounter with the word helps the learner get partial knowledge of the word. In the English classroom, every difficult word is explained through meanings. Without learning the meaning of the word, the recognized status of the word eventually becomes null and void and the learner gradually forgets even the orthographic form of the word. And meaning is the aspect that opens doors for the possibility of using that word productively when the time comes. So, as learning meaning is the second step towards learning the word, matching words with their meanings was included as the second item type. In pilot study1, this particular aspect was assessed through multiple-choice item type. But, as the students were not comfortable with that item-type, it was replaced with the present item type.
Words in pairs

Almost simultaneously with learning meanings, one learns the other words which mean more or less as the target words. When one infers meaning from the context, if the contextual clues are available, one remembers another word whose meaning is equivalent to the target word. Hence, as knowing a word includes what the possible synonyms or antonyms of the word are, the third item type was designed to measure learners’ knowledge of the relation between a word and its pair.

Fill in the blanks

After learning the meaning and synonyms / antonyms of the word, learners expand their knowledge of the word by learning the inflections and derivatives of the word. Hence, the fourth item type wanted to measure the productive ability of the students with respect to the target word. A passage was given with 10 blanks. 10 words were also given. And the learners had to decide which word would go with which blank and also whether it was necessary to change the form of the word according to the given sentence structure.

Using the words in own sentences

A word is considered to be learnt to a good extent, if the word is used in a meaningful and grammatically acceptable sentence in the sense that the meaning of the word is represented by its use in the sentence. Take for example, the word unequivocally and the two sentences using the target word.
He stated his intentions unequivocally. Unequivocally is a word where un- is a prefix.

The first sentence clearly manifests the knowledge of the student about the target word whereas, the second sentence does not give any clue whatsoever to know whether the learner knows the meaning of the target word. Hence, the fifth and the last item type wanted to measure that kind of knowledge which the first example sentence illustrates.

**3.2.7 Pilot Study 2**

It is already mentioned that two separate lists of words were prepared. English and engineering (EE) contained words that appeared in both the engineering textbooks and English textbooks. Only Engineering (OE) contained words that appeared only in the engineering textbooks. These 300 words were used to develop six tests (Appendix E). Each test consisted of 50 target words. Of these 50, 25 words were taken from EE and the other 25 were taken from OE. Each test had five sub tests. All the six tests contained the same item types. Again, each subtest had 10 target words, of which 5 were taken from EE and 5 from OE.

A second pilot test was administered to 18 students and the reliability of the test was calculated at 0.71. The construct validity for all the five subtests was calculated as before. The result is given below.
I subtest – 0.72
II subtest – 0.78
III subtest – 0.79
IV subtest – 0.74
V subtest – 0.81

As the reliability estimate was encouraging and as it was proved that the five subtests had a positive correlation with the total test, it was decided to go on with the main study.

3.2.8 Student Information Sheet

A student information sheet (Appendix C) was given to the students to learn about their reading habits, medium of instruction up to 10th standard and in Intermediate and so on. The students were to fill in the sheet at time of the pre-test and the post-test. But, there was a small difference.

The first time, they were asked to answer the question, *Do you expect the English textbook to help you in the areas you need improvement?*” This question was asked to know the purposes for which the learners approach the English textbook. The second time the question was changed to *Has your English textbook helped you in the areas you need improvement?* This change was made to know whether the learners’ assessment of their own knowledge was correct.
3.3 The Main Study

As 0.71 was an encouraging reliability estimate, it was decided to proceed with the main study. 6 test papers were developed and a pre-test was administered to 600 students studying in six different private engineering colleges affiliated to JNTU.

3.3.1 The Engineering Colleges

600 students from six private engineering colleges in Andhra Pradesh were selected for administering the test. The six colleges are located in five different districts. They are:

1. GVP College of Engineering, Visakhapatnam
2. MVGR College of Engineering, Vijayanagaram
3. Godavari Institute of Engineering and Technology, Rajahmundry
4. Vignan Engineering College, Guntur
5. Nimra College of Engineering, Vijayawada
6. Nimra Institute of Science and Technology, Vijayawada.

3.3.2 Participants

600 students coming from diverse social, cultural and linguistic backgrounds took this test. The students were very enthusiastic about the test. It was told in advance to the students that cheating would not serve any purpose. They were told that marks would be
awarded, not for their performance, but for the effectiveness of the English textbooks. As they understood the point that the marks they get would not add to their overall percentage, the students behaved in a very disciplined way and extended their cooperation to the researcher without creating any problem.

3.3.3 Test Administration

A 50 minute period was taken for the purpose of test administration. The researcher got prior permission from the principals of the respective colleges. The researcher did not ask for and was not offered the presence of another teacher in the class. It was thought that two teachers in one class would make the students feel uncomfortable. Most of the students completed answering the test papers well before the end of the allocated time i.e. 50 minutes. Since speed was not the point, time was not enforced strictly. Those who could not complete the test in time were given extra time.

3.3.3.1 The Pre-test

A pre-test was administered to the students at the beginning of their first year. As there were 6 test papers, care was taken that students sitting in one bench got different question papers. They were not told that the same exercise would be repeated at the end of their course work to ensure that no deliberate learning would take place between the pre-test and the post-test.
3.3.3.1.1 Data Analysis of the Pre-test

As mentioned earlier, reliability estimate was calculated for each test paper separately. The result is as follows:

<table>
<thead>
<tr>
<th>Test</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test A</td>
<td>.66</td>
</tr>
<tr>
<td>Test B</td>
<td>.74</td>
</tr>
<tr>
<td>Test C</td>
<td>.66</td>
</tr>
<tr>
<td>Test D</td>
<td>.71</td>
</tr>
<tr>
<td>Test E</td>
<td>.74</td>
</tr>
<tr>
<td>Test F</td>
<td>.74</td>
</tr>
</tbody>
</table>

The result makes it clear that the test is a reliable one because the reliability of a good classroom test generally falls between .60 and .80 (Valette, 1997). We now move on to decide the construct validity of each subtest for each set of test paper. Here, St means Subtest.
<table>
<thead>
<tr>
<th></th>
<th>St 1</th>
<th>St 2</th>
<th>St 3</th>
<th>St 4</th>
<th>St 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test A</td>
<td>.80</td>
<td>.71</td>
<td>.76</td>
<td>.83</td>
<td>.78</td>
</tr>
<tr>
<td>Test B</td>
<td>.75</td>
<td>.73</td>
<td>.80</td>
<td>.84</td>
<td>.83</td>
</tr>
<tr>
<td>Test C</td>
<td>.68</td>
<td>.78</td>
<td>.78</td>
<td>.75</td>
<td>.76</td>
</tr>
<tr>
<td>Test D</td>
<td>.86</td>
<td>.71</td>
<td>.75</td>
<td>.79</td>
<td>.81</td>
</tr>
<tr>
<td>Test E</td>
<td>.81</td>
<td>.71</td>
<td>.80</td>
<td>.82</td>
<td>.81</td>
</tr>
<tr>
<td>Test F</td>
<td>.87</td>
<td>.82</td>
<td>.79</td>
<td>.83</td>
<td>.80</td>
</tr>
</tbody>
</table>

The result shows that each subtest has strong correlation with the total test which makes the test valid.

### 3.3.3.2 The Post-test

The post-test was administered to the students at the end of their first year. Of the 600 students, 312 students wrote the same test as in the pre-test and 288 students wrote a different test. This was done to find whether the administration of pre-test had any effect on the learning process of students.

#### 3.3.3.2.1 Data analysis of the Post-test

We will now look at the reliability estimates of the post-test for each set of test paper separately. The result was encouraging.
<table>
<thead>
<tr>
<th>Test</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test A</td>
<td>.75</td>
</tr>
<tr>
<td>Test B</td>
<td>.79</td>
</tr>
<tr>
<td>Test C</td>
<td>.76</td>
</tr>
<tr>
<td>Test D</td>
<td>.82</td>
</tr>
<tr>
<td>Test E</td>
<td>.81</td>
</tr>
<tr>
<td>Test F</td>
<td>.80</td>
</tr>
</tbody>
</table>

Construct validity for each subtest was estimated for each test paper.

<table>
<thead>
<tr>
<th></th>
<th>St 1</th>
<th>St 2</th>
<th>St 3</th>
<th>St 4</th>
<th>St 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test A</td>
<td>.87</td>
<td>.85</td>
<td>.82</td>
<td>.88</td>
<td>.86</td>
</tr>
<tr>
<td>Test B</td>
<td>.92</td>
<td>.86</td>
<td>.90</td>
<td>.90</td>
<td>.89</td>
</tr>
<tr>
<td>Test C</td>
<td>.91</td>
<td>.87</td>
<td>.86</td>
<td>.86</td>
<td>.84</td>
</tr>
<tr>
<td>Test D</td>
<td>.93</td>
<td>.90</td>
<td>.91</td>
<td>.90</td>
<td>.84</td>
</tr>
<tr>
<td>Test E</td>
<td>.91</td>
<td>.91</td>
<td>.92</td>
<td>.88</td>
<td>.85</td>
</tr>
<tr>
<td>Test F</td>
<td>.90</td>
<td>.88</td>
<td>.86</td>
<td>.88</td>
<td>.84</td>
</tr>
</tbody>
</table>

The result shows that all the subtests have high positive correlation with the total test which makes the test valid.
3.4 Method of Scoring

As the target words were grouped into different subtests according to their level of difficulty, a score of one was given to the correct response irrespective of the item type in which the target word was presented. Subtest wise results are given in Appendix F

Subtest 1

The first subtest presented 10 words to the students who in turn had to tick beside the words they knew. Explicit instructions were given to the test takers to tick beside the words they knew existed. They could tick even if they did not know the meaning of the word. If they had seen it somewhere, they could tick beside the word. There were 10 target words in this subtest. For every tick mark, a score of one was given. A test item is given below.

I Tick beside the words you know.
- appreciable
- orientation
- progressive
- eroded
- indispensable
- exaggerate
- expulsion
- incoherent
- ridiculed
- whirl
Subtest 2

The second subtest was a ‘Match the Following’ item type. 10 words and their meanings were given in two separate columns. The learners were asked to match the words with their respective meanings. For every correct answer, a score of one was given. A test item is given below.

II. Choose the right word to go with each meaning. Write the number of that word next to its meaning.

A                           B
1. distort                  having strong moral principles _____
2. intrinsic                that can be noticed _____
3. integrity                getting rid of something _____
4. abundant                 twist out of its usual shape _____
5. eliminate                having traditional attitudes _____
6. consolidate             more than enough _____
7. conservative            put a limit on _____
8. observable               taking out _____
9. restrict                 existing within _____
10. extracting              unite things into one _____

Subtest 3

The third subtest presented 10 pairs of words to the test takers. Words in pairs might share a similar meaning, or they were opposite in meaning or they were completely unrelated to each other. Learners had to find out the relation between these pairs of words. For every correct answer, a score of one was given.
III. Here are 10 sets of words. Words in each set may be similar in meaning, approximately opposite in meaning or completely different. In the space provided, write S if the words are similar, write A if the words are opposite and write D if the words are different.
1. adapt        adjust    _____
2. depletion      decrease   _____
3. compact      expand    _____
4. profitable      instruct    _____
5. rigorous     strict     _____
6. consumption   conservation   _____
7. predominant    trivial     _____
8. implicit     understood   _____
9. resulting      observe   _____
10. occupancy     abrupt     _____

Subtest 4

The fourth sub test offered the learners a passage with 10 blanks. 10 words were given to be used in these 10 blanks. Test takers had to change the form of the words, if necessary, to fill in a blank. This subtest tested the learners’ ability to manipulate a given word according to the sentence structure. For every correct answer, a score of one was given.

IV. Fill in the blanks changing the form of the given words if necessary.
amaze    simple   effect     practice   frequent
          economy      rely        tedium      relax         quite

A discussion between a sales person and a couple.
A. Good morning Sir, I am from ‘Clean Home’ Sir. Madam, Good morning ma’am!
B. We are busy at present. We don’t need any vacuum cleaners now.
A. Okay, Sir! But, just have a look at the beautiful machine Sir. This is the _______bought vacuum cleaner Sir. Ma’am, this _______your work ma’am
B. I heard it is very costly.
A. Who told you that Sir? It is very _______and at the same time very _______also.
C. Any how, my husband has already told you that we don’t want to buy it now.
A. You please sit down ma’am. Sir, your house is ________ beautiful, Sir. Ma’am, it’s _______ how you could do all this without a vacuum cleaner. Sir, if you buy one, ma’am can _______ a bit.
B. Any way, I think I have some work.
C. Be ________, my dear. Why don’t you buy that for me? You know how ________ household works are? You are always engaged with your work and I have to ..........

Subtest 5

The last subtest was a production item type. 10 words were given in this section. The test takers had to use the target words in their own sentences. They could write 10 individual sentences or construct a small passage using all the 10 target words. If the sentence was grammatically correct and the target word was used in a meaningful context, a score of one was given for each correct response.

V. Use the following words in your own sentences. You are free to construct a small passage or a dialogue using the given words. You can change the form of the words, if necessary.

assume exclude intend reveal fundamental
denote insert omitted tempting negligible
3.5 Formulae used for Data Analysis

As there were 6 different sets of test papers, reliability estimate was calculated for each set of paper separately for the pretest and the main test.

First the mean score i.e. $\bar{x}$ was found out by using the formula $\frac{\sum x}{N}$

where $x$ is the individual score of the learners and $N$ is the total number of students who took the test. After finding out the value of $\bar{x}$ Standard Deviation was arrived at by using the formula

$$S = \sqrt{\frac{1}{n} \sum x^2 - (\bar{x})^2}$$

Where $n = \text{total number of students}$

$x = \text{individual score of a learner}$

$\bar{x} = \text{mean score}$

After finding out the value of Standard Deviation, reliability of a test paper was estimated using the formula

$$r = 1 - \frac{m(n-m)}{ns^2}$$

Where $r = \text{reliability}$

$m = \text{mean}$
\[ n = \text{number of items in the test} \]

\[ s = \text{standard deviation} \]

The construct validity was estimated by correlating each subtest with the total test. The formula used to calculate the correlation quotient ($\rho$) between each subtest and the total test is as follows:

\[
\rho = \frac{1}{n} \frac{\sum xy - \bar{x} \bar{y}}{\sigma_x \sigma_y}
\]

Where \( n = \text{number of respondents} \)

\( x = \text{scores of the total test} \)

\( y = \text{scores of the subtest in question} \)

\( \bar{x} = \text{mean of the variable x} \)

\( \bar{y} = \text{mean of the variable y} \)

\( \sigma_x = \text{Standard deviation of the variable x} \)

\( \sigma_y = \text{Standard deviation of the variable y} \)
The result generally falls between -1 and +1 and the nearer it is to +1, the better correlation the sub test has with the total test. The result shows that all the subtests have high positive correlation with the total test which makes the test valid.

The results showed that the developed test papers were reliable and constructs had positive correlation with the total test which made the test items valid. This means that one can make valid and reliable inferences from the results. The results were analyzed in the next chapter using a paired Z-test and Pearson product-moment correlation coefficient.