Effectiveness of Teaching Engineering in English with Specific Purpose

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ABSTRACT
This paper presents a comparative study on the effectiveness of teaching an engineering course using English with Specific Purpose (ESP). A study was performed using student groups; one class using ESP, and one class conducted in English with an English text. The course conducted using ESP showed the greatest improvement in English writing and conversation, and the students reported a greatly increased confidence in their ability to function professionally using English.

A self-assessment of each student was conducted before and after the courses. Prior to the course less than 10% in each group felt that they are able to: a) understand a textbook, b) write an email, c) generate a project report, or d) follow a lecture given in English. The survey at the end of the course showed that the ESP teaching style resulted in significant improvements in students' ability and confidence with writing and speaking in English, whereas reading skills were similar for both groups. This is due to the ESP method, in which students are required to give presentations and keep journals in English.

After a brief review of the ESP principles and a discussion of how they were implemented, the background data of the participants (students) are described. Finally, the end-of-semester survey highlights the efficacy of the ESP approach.

Keywords: Engineering Education, English with Specific Purpose, Confidence, Professional Communication, Engineering in English

I. Introduction and Background

Korean engineering and construction companies operating in today's global market depend on engineers who are educated not only in the traditional fields, such as steel or concrete design, but are also able to function effectively in foreign countries. English has the international language in science and technology and is recognized as being essential for Korean engineers as well. In fact, the majority of textbooks engineering are written in English. English as the predominant language emerged because of the role the

United States and Britain played during and after World War II in advancing engineering science. Because scientific progress was considered an important "battlefield" during the Cold War, engineering colleges in US universities was heavily funded by the US government. For example, success with the Apollo program was spurred by scientific progress in many areas including civil engineering. Because of these science and engineering advances, American industry and commerce became dominating force throughout the world. As a result, professors and university administrators became interested in enhancing their students' English skills in order to improve their employability worldwide (Radu 2006, Marginson et al., 2004).

During the last decade, engineering education has received
increased attention from researchers. For example, Bernold (2008, 2006, 2005) identified the lack of learning skills by students, the missing pedagogical background of engineering professors and the deep compartmentalization as key hurdles inhibiting advancements in engineering education. Anson et al., 2003 demonstrated that the paradigm shift in teaching engineering depends on empowering the students to be responsible for their own learning. Saad and Elgammal (2003) and Palmer (2000) reported their successes in applying novel concepts in integrating professional skill learning into their classroom activities, that students would learn more and understand more fully.

English is the lingua franca in engineering. People from countries whose language has Anglo-Germanic roots find it much easier to learn English than do people from most Asian countries. Like most countries around the world, English education in Korea begins primary school classes and continues the secondary and tertiary level. At the university level incoming students have a minimal proficiency that can be built on during general English classes in the freshman and sophomore years.

Widdowson (1978) studied traits of oral communication and found that the way different disciplines or professions speak and write varies considerably. In the 1960s the dissimilarities between business and engineering oral conversations was recognized as significant enough as to warrant specialized approaches to teaching English in each area. The sole focus on vocabulary, phonology, structures, function, and listening comprehension was insufficient. Widdowson (1978) wrote that: "...the acquisition of linguistic skills does not seem to guarantee the consequent acquisition of communicative abilities in a language." Later, Dudley-Evans (1998) made a distinction between simply teaching a subject matter in English versus teaching English in a way that enables students to perform in a specific discipline. These observations gave birth to a new field of research referred to as teaching English with Specific Purpose (ESP).

1. English with Specific Purpose (ESP) for Engineering

Dudley-Evans (1998) offered the following mission statement: "ESP has to involve the teaching of the language and the skills associated with... a discipline. Materials will be devised based on the analysis of particular lexis and genres used by the discipline. The primary purpose is not to teach the subject content, but to provide learners with sufficient awareness of language, rhetoric and study skill to enable them to learn the subject content." Hence, ESP is less focused on teaching the subject content in English, but rather on enabling students to learn the subject matter skillfully on their own. Thus, ESP’s goal should be preparing students for life-long-learning by instilling effective and efficient learning skills.

Based on the widely accepted definition of ESP by Dudley-Evans and John (1998), following objectives for teaching English as a foreign language in Civil Engineering can be established:

1) The exposure to English in an engineering course should be designed around the specific content of a course. In particular, exercises need to be developed that let the students acquire the skills necessary to apply the content material and to understand the relationships to other content areas in the same field.

2) ESP needs to meet the specific needs of the learner as it relates to learning preferences and effective study skills. The goal is to develop self-directed learners.

3) ESP focuses on improving the language proficiency in the subject area in terms of grammar, lexis, discourse and genres.

4) ESP has to include all areas of communication—reading to understand, writing, and oral presentation.

III. ESP Curriculum for Construction Engineering & Management

The sophomore course, CIE-261, Introduction to Construction Engineering and Management, is also a preparation class for the Korean Civil Engineering Fundamental Engineer. "The Live Construction Engineering (살아있는 건설시공학)" is used as a textbook and practice sessions are done in
Korean by a graduate assistant based on the "The New Civil Engineer Practical Test (신경향 토목기사실기)".

The main assignment for students in the ESP is the weekly journal addressing class topics and each student's personal notes about what they learned from the class. The goal is to acquire a professional writing style and to build confidence while writing in imperfect English that can be understood and improved on over time.

Following are the related CIE-261 features matched to the aforementioned ESP principles.

• **English exposure**: The course introduces the world of construction equipment, methods and management. The content links readily to physics math mechanics, soil mechanics, structural design, materials, and history of technology. The internet material in English (written, graphical, photos with captions, YouTube videos, codes, etc.) that can be used by students to learn how to teach themselves.

• **Improving study skills**: Participatory teaching ('around the circle'), tests, quizzes, semester field-project, journaling, time-management, mind-mapping, and sketching are also emphasized.

• **Improving language proficiency (grammar, lexis, discourse and genres)**: Journal writing included the review of 15 new English words each week. During class sessions, students translated new words with cell-phones. The instructor called on individual students to answer questions. They also practiced writing professional e-mails, proper report format, and each student gave an oral presentation about a subject on the syllabus.

• **Providing experience in all areas of communication—reading, writing and oral presentation**: Each students gave two oral presentations: one in the middle of the semester and a second at the end. Students’ journals and term project reports counted toward their final grade. Sketching, professional email, reading skills and comprehension were developed using these techniques.

Writing weekly journals gave students the opportunity to work on the following proficiencies:

• Organizing a professional report

• Summarizing what happened during the week

• Reflecting on the most important aspects of the week (higher level thinking)

• Expanding their engineering and general vocabulary

• Practicing sketching as a communication method for engineers

• Using spell and grammar checkers

• Responding professionally to e-mails

• Linking the class to their existing knowledge and the world around them

Journal writing addresses all four ESP principles. Considering that English journal writing for Korean engineering students is a new experience, it constitutes a major challenge. With this in mind, students are asked to hand in their work in progress at least twice during the semester for review and comments by the teacher. At these times, no grades are given; instead, recommendations are given by the instructor on how to make improvements. Over the course of the semester, significant transformations are seen from poor to very good journals. Eventually, the students gain confidence and became interest in journal writing, they actively write and ask for a review to improve their journal.

Interactive classes included slide shows with pictures from the real world. The semester project required the students to visit a construction site to conduct time and motion studies. Each student’s oral presentations were critiqued by the instructor. Marked improvements in both English usage and understanding of the course materials were seen in the end of semester term projects.

IV. Methods used for determining the effectiveness of ESP

At the beginning of the semester, students were surveyed about their English proficiency and experience with using English in various situations. They were also asked about their level of confidence with respect to improving their skills in general (not specific to language).

Both student confidence surveys and class results were used at the end of the semester to determine improvements in confidence and improvements in skill and knowledge.
Evaluation of class results included page count of reports, and number of presentations, and evaluation of the journal. A sample of a student’s journal is included in the Appendix.

Reliability

We used three surveys in addition to an objective measure of students’ progress to ensure consistency of the result. Two pre-class surveys asked the students about (a) their past experience with using English and (b) their confidence in using English. Although the questions in each survey were different, they all focused on the same three aspects of using English with confidence—reading, writing and speaking. The objective data (also concerned with speaking, reading and writing in English) agree with the self-assessments at the end of the class.

Reliability and consistency of the survey data can also be assumed because the average subjective answers (survey data) agree with the average objective results (numbers of pages written, reports given, etc.). The students’ backgrounds (determined by survey) also agreed with their own self-assessments regarding their experience and proficiency with English. For the post-class evaluation, the students’ post-class self-assessments agree with the objective data on the number of pages written, oral reports given, etc.

V. Results

1. Prior English Education of Korean Engineering Students

Learning takes place by adding new facts to already existing knowledge. Through practice we gain skill. Naturally, at the beginning of an ESP class one wonders how proficient the students are to gauge the exposure level. Before the ESP class began, a questionnaire was created and filled out by two groups of engineering students.

Prior to the beginning of the classes, the students showed similar levels of confidence with respect to their ability to use English. Few students spent time in a foreign country and none had worked for a company where English was the primary language used for business. Only 30% had already taken more than two courses in which English was used in the classroom. 30% had not yet read a book in English and another 30% had read one or two books. Approximately 40% had not written a full page in English and only 20% created as much as two pages. Finally, 80% to 90% of the students had never made an oral presentation in English. The data reflect a lack of practical experience with spoken English and a teaching approach that does not stress the skills necessary for writing and oral communication.

2. Pre-Class Student Self-Evaluation

The last section of the survey addressed how the students viewed their own proficiencies in English. Although this approach provides only subjective data, it nevertheless tells us about their confidence level and their willingness to exert extra effort in a class that asks them to learn both engineering and English. Fig 2 shows the result of the survey separated according to two courses: 1) Engineering with ESP, and 2) Engineering taught in English.

The students’ misperception of the need for English communication is seen in the responses to questions 1 and 2. While only 19% of the students thought they understood English well, more than 68% thought that their level was sufficient for engineers.

This result probably reflects their view that they will work in Korea with other Koreans rather than working in an international company. Responses to questions 4 through 8 support this hypothesis in that less than 10% asserted that they were able to write a project report or a professional email. Slightly more believed that they were able to follow a lecture given in English (question 3).
Percentage of Students Who Answered "Yes"

<table>
<thead>
<tr>
<th>Statement</th>
<th>ESP Engineering Class</th>
<th>Non-ESP Engineering Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>I understand English well</td>
<td></td>
<td></td>
</tr>
<tr>
<td>My English is sufficient for engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I understand a lecture in English</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can write a professional e-mail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I'm afraid to ask questions in English</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can write a project report in English</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I understand a textbook written in English</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I prefer courses that challenge me to learn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This class will be my hardest ever</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I will spend extra time to work for this class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I will benefit from this class</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig 2 Students’ Self-Assessment of Their English Skills

Many of the students (44% of the ESP engineering class and 20% of the non-ESP engineering class) thought that taking a course taught in English would be their hardest ever (question 9). Finally, 96% of the ESP but only 71% of the non-ESP class judge that they will benefit from taking engineering in English (question 11). Overall, the data suggest consistency between the two groups, with slight variations.

3. Post-Class Evaluation

Towards the end of the semester, the two groups were surveyed again with a second questionnaire in order to measure the student’s learning experiences and their self-assessed progress in English. The number of students is slightly different from the pre-class surveys as some of them had dropped out or were not present during the day of the in-class survey.

Table 1 shows the objective measures of performance for ESP versus the traditional English-lecture-style course. Although ESP-taught class used a Korean textbook, it was not the primary reference for the students. Instead, they relied on lectures and English-language handouts. On average, the students in the traditional class taught in English read 78.3 pages of English text (handouts and outside source materials). The students in the class taught in English read more pages in English (116.1), but this is probably a reflection of the fact that their textbook was written in English. Interviews with students suggest that the reading done in the non-ESP class was primarily to find formulas and equations and to do homework.

The benefit of the ESP approach to teaching is more clearly shown in the number of pages that were written and the number of student presentations given. The ESP students wrote an average of 42.7 pages of English text, compared to an average of 3.5 for the traditional English-taught class. The ESP students gave an average of two oral presentations (again in English), compared to 0.1 presentations given by students in the traditional English-taught class.

<table>
<thead>
<tr>
<th></th>
<th>No. of Pages Read in English</th>
<th>No. of Pages Written in English</th>
<th>No. of Oral Presentations in English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering with ESP</td>
<td>78.3</td>
<td>42.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Engineering taught in English</td>
<td>116.1</td>
<td>3.5</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Students Progress in English

![Bar Chart: Students Progress in English]

Fig. 3 End-of-Semester Comparison of Study Habits and Progress in English

Fig 3 provides a summary of the survey given to the students at the end of the term. The most significant difference between the two groups is demonstrated by question 2, related to their confidence in using English to speak and write. While 71% of the ESP-taught students had improved confidence a lot, none of the non-ESP-taught students noted any difference in confidence levels. The students were also asked whether they felt their knowledge of English had improved question 1). In the traditionally-taught class, 19% of the students reported that their knowledge of English did not improve at all, but none of the ESP-taught students felt that way. 36% of the ESP-taught students felt that they had made a lot of progress in understanding English, while only 8% of the non-ESP group said they had made a lot of improvement in English understanding. The responses to questions 4, 5, 6, and 7 show a similar pattern in that approximately 90% of the ESP-taught students adopted active study habits such as working in groups, creating a notebook or getting help from other sources, whereas only 35% of the traditionally-taught students adopted new study habits. Moreover, 40% of the ESP-taught students expressed that they used those tools intensively.

VI. Conclusion

The premise of ESP is to teach English in the context of a discipline, such as engineering. It is not so much the discipline’s specific vocabulary that is of importance but its unique historic culture and the job-specific communication standards that the students need to become fully functional. A example is writing a professional email. While this was not expected from an engineer graduating in 1995, it has become a necessity for engineers who work on international projects today. As shown by the students’ self-assessment which was done at the beginning of the course, only 10% of the Korean engineering students thought that they could write such an email.

The data presented in this paper are based on surveying 100 engineering students at a large private university in South Korea. The surveys were conducted at the beginning and at the end of two courses, one of which was taught by lecturing in English and the other was taught using the ESP methods. Information about the students’ background was collected and compared with the results of an end-of-class survey querying their self-evaluated progress in English.

A questionnaire given at the beginning of the semester focused on the students’ background and confidence in using English. The results indicate that the 60% who had taken the required English classes were uncomfortable with reading books, writing, and giving oral presentations in English.

Despite the fact that only 10% agreed that they could write a professional email or write a project report in English, more than 68% of them felt that their knowledge of English is sufficient for engineers. This finding indicates a misperception held by the students about functions that go along with being an engineer in a global world. However, many said that they had no aspirations to work internationally anyway.

The improvement in confidence and proficiency in English was evident in the ESP-taught students. While only 8% of the students lectured in English, that they made “a lot” of progress in English, over 36% of the ESP-taught students believed that they had made significant progress. This survey supported the results of previous studies that practicing professional reading, writing and oral presentations tailored to engineering accompanied by effective study habits not
only their knowledge of English, but more importantly increase their confidence. 71% of the ESP-taught engineering students stated that their confidence increased “a lot” compared to 0% of the traditionally-taught engineering students.

A single class using ESP is significant step toward preparing students to work in a global economy. ESP-based engineering courses are highly effective in improving the students’ professional English communication skills and the confidence. Adding subsequent opportunities for the students to learn and practice the ESP system will greatly assist Korean students who want to become fully functional global engineers.

References


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Appendix: Excerpts from a Semester Journal

Attached appendix is a excerpts from a semester journal of Hyunhee Park, who was taking the ESP engineering class. She was one of the best students of the class. It was surprised that although she have never been to English using countries but she had improved her English skill dramatically. Hyunhee Park consents to the use of this journal as an appendix in this publication.

Getting Excited About Construction!

My Learning Journal

by

Hyunhee Park

Introduction to Construction Engineering and Management
Department of Civil and Environmental Systems Engineering

Hanyang University

December 10, 2009
Executive Summary

Do you know if your construction project operates without large mud-waste? If you can, what makes you so sure? Let's turn the pages if you want to get clues to these questions: all the answers are in this journal.

The long race writing my class journal during this semester was hard. I had great obstacles because my “English” was lacking behind the other students. However, after I put a lot of my energies into my journal, it gives me a sense of achievement. Don’t you want to see what I accomplished? Don’t you want to know how much exciting engineering I learned and how I feel today? I think you do! So, let’s go!

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   1.2 How to Communicate in Construction
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A. WEEKLY ACCOUNTS

1. A New Professor and a New Class (Sep. 1, 3, 2009)

This class “Introduction to Construction Engineering and Management” started on Tuesday, Sep. 1st. Our new semester also did the same date. I was very anxious starting this semester with this class; because, it is my first class relating to fields of Construction Management and only English class with a foreign professor.

1.1. Introduction

1.1.1. Who is Dr. Bernold?

He was born in Switzerland which is famous for chocolates, and taught in North Carolina, USA. He has two daughters and a wife.

1.1.2. Professor’s Teaching Philosophy

His teaching Paradigm is “To make students be active and creative in class”, not “Pouring knowledge only from the professor”. He said the professor’s role is to help students be better as a sport coach. Rather than waiting that the professors cram knowledge into our head, he wants us to think about subjects and discuss the main point in this class with our classmates, our professor and whoever can help us. After attending the first class, my worries were gone and I gained confidence that I would do well in this class. I’m looking forward the next class!

1.1.3. Reading Skills

- Skimming
  - Read the contents, go through pictures, graphs and so on

- Reading Carefully
  - Underline and highlight the main sentence, if necessary, take notes in the margin

- Organize Concepts
  - Draw the table assembling, map knowledge

1.2. The Most Interesting Things I Learned this Week

I was very impressed by “Sketching”. The professor reminds me and teaches us how to draw. There are many teachers who indicate us knowledge like Newton’s law, integration, something like that; on the other hand, there are few ones who teach us how to communicate and how much sketching is powerful language. Whenever new ideas come into our heads, we can record in our notes through sketching. Its power will work in the future, for creating new device and improving malfunctions etc. Besides we can understand what is happening in the construction more easily.
1.3. New Words of this Week

<table>
<thead>
<tr>
<th>English</th>
<th>Korea</th>
<th>Meaning in Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation</td>
<td>혁신</td>
<td>The term innovation refers to a new way of doing something. It may refer to incremental and emergent or radical and revolutionary changes in thinking, products, processes, or organizations.</td>
</tr>
<tr>
<td>Crane</td>
<td>기중기</td>
<td>A crane is a lifting machine, generally equipped with a winder (also called a wire rope drum), wire ropes or chains and sheaves that can be used both to lift and lower materials and to move them horizontally.</td>
</tr>
<tr>
<td>Paradigm</td>
<td>보기에 벌레 모양</td>
<td>A paradigm is a model for something which explains it or shows how it can be produced. A paradigm is a clear and typical example of something.</td>
</tr>
<tr>
<td>Pulley</td>
<td>도로리</td>
<td>A pulley, also called a block and tackle, is a mechanism composed of a wheel (called a sheave) with a groove between two flanges around the wheel's circumference. A rope, cable, belt or chain usually runs inside the groove. Pulleys are used to change the direction of an applied force, transmit rotational motion, or realize a mechanical advantage in either a linear or rotational system of motion.</td>
</tr>
<tr>
<td>Skim</td>
<td>대충 올리다</td>
<td>If you skim a piece of writing, you read through it quickly.</td>
</tr>
<tr>
<td>Rope</td>
<td>줄</td>
<td>A rope is a length of fibers, twisted or braided together to improve strength for pulling and connecting. It has tensile strength but is too flexible to provide compressive strength (i.e. it can be used for pulling, but not pushing). Rope is thicker and stronger than similarly constructed cord, line, string, or twine.</td>
</tr>
<tr>
<td>Appendix</td>
<td>부록</td>
<td>An appendix to a book is extra information that is placed after the end of the text.</td>
</tr>
<tr>
<td>Hopper</td>
<td>할때기 모양의 그릇</td>
<td>A chute with additional width and depth to provide a volume for temporary storage of material(s). The bottom of the hopper chute typically has a mechanism to control the flow of materials, thus allowing them to be metered out at the desired rate.</td>
</tr>
<tr>
<td>Philosophy</td>
<td>철학</td>
<td>A philosophy is a particular theory that someone has about how to live or how to deal with a particular situation.</td>
</tr>
<tr>
<td>Journal</td>
<td>일지</td>
<td>A journal is an account which you write of your daily activities.</td>
</tr>
</tbody>
</table>

1.4. My Favorite Sketch: The Big Truck

During class, we practiced sketching four side views. The pictures of model weren’t right sides. Those were hard for me to catch out what each side of the machine was like. There was no choice but guess.

![Figure 1.5 First Week’s Favorite Sketch – Practice to Sketch with “Orthogonal” Format](image-url)
2. What is Construction Management? (Sep. 8, 10, 2009)

We learned what is about construction this week. Terminology in construction was very strange and a little difficult for me, for I've never studied Construction Management. I had to read over and over again until I got it. Though it took long time to finish reading the textbook, it was interesting.

2.1 Let's Play: What is Happening on the Construction Site?

We had learned that showing pictures or motion of process was easier than reading words in aspect of figuring out. We were able to realize this lesson through the next task.

![Backhoe Excavator and Trench](image)

(a) Text Material to Practice  
(b) Pictures of New Construction Words  
(c) Mapping the Situation on Site

**Figure 2.1 Ways to Help us Understand Written Content More Easily**

At first, we went through short text (a) and looked for new words. And then, we confirmed what each word meant through pictures. After that, we played and mapped processes written in the paragraph. There are pictures for understanding what we did during class in Figure 2.1.

Many figures and unfamiliar words which were names of equipments in paragraphs made us confused. Still, we were able to understand the situation in the construction soon after mock-playing with substitutes for real equipment in construction, such as a basket for a pipe, a string for a chain, stick for a backhoe boom, and two students for towers holding high Volt electricity cable, etc. I was the laborer who had to hold the pipe but was killed when backhoe hit power line.