

Teaching Technical Courses in Japan in English

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abstract

This paper discusses an attempt to overcome the problems in teaching technical courses at an engineering college in Japan. One American engineering professor was invited to teach such courses for one term in collaboration with Japanese professors of engineering and of foreign languages. Fundamental problems and constraints are discussed with our experiences and the concluding suggestions and recommendations are presented.

1 introduction

Recently, in technical colleges in Japan, there are many attempts to educate undergraduate and postgraduate students in technical courses in English. The main objective of the courses is to educate students who are expected to work after their graduation as global engineers to be the support and driving force of Japan in the English-speaking world of the 21st century. The global engineer is difficult to define itself, however, he/she will be generally required to have acquired at least the five abilities: basic engineering knowledge in English, communication ability in English, creativity, management ability, and international sense^(1,2).

Kanazawa Institute of Technology (KIT)⁽³⁾, Japan has made to start at its Mechanical Engineering Division an attempt to teach students technical courses in English by a native English-speaking professor associating with Japanese teaching staff. This attempt aims to clarify in advance the teaching problems to prepare for regular engineering courses in English. After the extensive preparation, two engineering courses in English were offered in the fall term, 2001, starting from the end of August and ending the middle of November. Both courses, technical report writing for undergraduate students and the compressible fluid for postgraduate students, met once a week for two sixty-minute periods (120 minutes per week for each course). The courses were offered for the first time at KIT to meet mechanical

engineering students' schedule and needs.

2 background

We think that teaching courses in English at colleges and universities in Japan pose many challenges. In such courses, students are required to understand the pattern of thinking behind the language as well as to comprehend the language itself. The comprehending English is the first step of the learning process in the courses and is a difficult task for technical majors. Some students who have chosen to learn natural science in colleges have taken fewer courses in English in high schools. Many of them express their uncertainty for communicating in English. English education in Japan starts formally in junior high school at twelve years of age. Students therefore have learned English for six years before they enter colleges or universities. During this period, the majority of them have experienced entrance examinations to be accepted by high schools of their choice. They proceed to take college entrance examinations. These entrance examinations are well known as "the examination hell," and students in Japan have to memorize large amount of knowledge to face the examinations. This fact leaves the students little time for expressing their opinions orally and in writing, even in their native language – Japanese, let alone in English. When these students enter college they have difficulty in performing these tasks. Science majors are particularly prone to these problems.

3 engineering courses in English

3-1 KIT and English background of students

KIT is a technical college with thirteen engineering divisions and with approximately 8,000 undergraduate and 500 postgraduate students in which approximately 1200 undergraduate and 80 postgraduate students belong to Mechanical Engineering Division. The students take at least 8 credits of mandatory English courses and some continue to take elective English courses. Though these courses deal with some technical English, class times are spent mostly for general English education. The students come with various backgrounds from comprehensive high schools and technical high schools. In general, students from technical high schools have less English classes than those from comprehensive schools. For these students, courses taught in English can be quite challenging.

3-2 technical report writing course

The theme and the objectives of the course are to improve students' English communication skills in listening, speaking, reading, and writing. The students will do so by attending a

series of lectures, by doing some simple homework assignments, by writing a report on the research projects they were doing that time, and by giving oral reports on their written reports. They were expected to learn how to write engineering reports. It was hoped that what they learned could be applied to writing reports in any language.

The technical report writing course followed the schedule below.

Week	Class content
1	introduction of the course preparing a brief memo explaining the student's project (due Week 2)
2	discussing content of a report, title page through reference and bibliography preparing a short outline for an individual report (due Week 3)
3	discussing graphical presentations preparing the abstract for a report (due Week 4) second hour: mini-oral presentations (self-introduction) in English
4	advising and reviewing preparing the introduction, conclusions, and recommendations of a report
5	discussing tabulation
6	discussing oral presentations
7, 8, 9	Oral presentations of the reports, feedback, questions and answers, comments

Eighteen senior students registered for the course. A native English-speaking engineering professor taught the course and two Japanese engineering professors served as advisers. Language problems were immediately discussed and remedied with a Japanese language professor.

Assignments were given to the students in order to prevent them from falling behind and to improve the quality of the final reports. They were corrected and returned to the students immediately.

3-3 problems and their remedies

In order to find problems early on, questionnaires were distributed (table 1) and interviews were conducted in Japanese. Classes were video-recorded to see how the students reacted to the lectures. The most apparent problem the students had during the lecture was listening comprehension. Even if they knew the words, they did not necessarily comprehend them by hearing the sounds. The use of overhead projector or PowerPoint is essential to help the students match the word and its sound. As the lecturer pronounced the important word, he could point out the word on overhead sheet or PowerPoint screen. Also noted was the font size. It should be large, ideally larger than point 36. It is difficult for non-native speakers to read even simple sentences so that the visual aid should be very clear.

Table 1. Questionnaire distributed at Week 2

<p>A. Background</p> <ol style="list-style-type: none">1. Please state your previous grades in English courses.2. What elective foreign language courses did you take if any?3. How do you evaluate your comprehension in English? Listening Reading Speaking Writing <p>B. lecture in Week 1</p> <ol style="list-style-type: none">4. How much did you understand? %5. What did you understand? Please write down what you remember.6. How do you feel about the pace of the lecture? Please choose one. Please give comments. Too fast, a little too fast, just right, a little too slow, too slow Comments:7. Did you find the professor's English clear? Clear, not very clear, not clear8. Did the examples the professor gave help you understand? Helpful, not very helpful, not at all helpful, didn't understand the example, didn't understand that was the example, others (comments)9. Were overheads helpful? Helpful, not very helpful, not at all helpful Comments: how can they be improved?10. What did you not understand in the lecture? Comments: how can it be more understandable?11. Did you understand the content of the syllabus and the objectives of the course (explained in Week 1 lecture)? Understood well, understood to some extent, did not understand very much, did not understand most of them, did not understand at all If you felt you didn't understand, do you think it is due to English? Or, is there any other reason?12. Any other comments, opinions, etc.
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Many students responded that they had trouble with vocabulary. Their lack of known vocabulary seems to be the largest factor to hamper their comprehension in English.

It was observed that most of the students expressed their regret for not studying English enough before this course and expressed their desire to study harder. It seems that facing the task in English boosted their motivation for learning English. There were very few complaints about the lecturer, and the students blamed themselves for any failure to understand the lectures. The students also tended to be modest in evaluation of their comprehension in the lecture and in English in general.

There were some surprises for both engineering and language professors that the students were not familiar with some seemingly basic English words. Terms the students had trouble defining are listed below.

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|--------------------------|-------------------------------|
| 1. annual | 22. hidden |
| 2. appendix | 23. instrument |
| 3. bibliography | 24. interpretation |
| 4. calibration | 25. mathematical formulations |
| 5. clutter | 26. plagiarism |
| 6. cogeneration | 27. previous work |
| 7. combine | 28. recommendation |
| 8. conclusion | 29. reduced energy costs |
| 9. conservation | 30. references |
| 10. consistent | 31. rehearse |
| 11. current study | 32. remove |
| 12. define | 33. requirements |
| 13. derivation(s) | 34. statement |
| 14. detailed | 35. successfully |
| 15. discuss(ed) | 36. sufficient |
| 16. equation | 37. summarize(d) |
| 17. equipment | 38. survey |
| 18. evaluation | 39. tabulation |
| 19. existing | 40. theoretical |
| 20. favorable | 41. uncertainty |
| 21. formulas/formulation | |

This list shows that one cannot simply anticipate students knowing so-called “basic” words. To find out what the students know and do not know is very important. Also, words should be learned in context. For example, survey or discussion can be used with many meanings. To define the words in right context, in this case, as they are used in scientific reports, is essential.

With these essential words unknown, the students obviously had great difficulty comprehending lectures. However, as the class proceeded, there were interactions among the students to help each other. The students with higher comprehension helped with defining words and even offered to translate for other students. In general, the course went well.

As the authors analyzed videotaped classes, it was observed that the tone of voice of the lectures helped the students maintain their concentration. Listening to lectures in foreign language with many unknown words can be very challenging. The listeners easily lose their attention. However, the professor’s occasional change and emphasis of his tone of voice caught the students’ attention. Therefore, it can be important for the speaker to vary his speaking tones.

Themes of the final reports the students chose are as follows. These are the themes of their senior thesis project.

cavitation
 diesel engines
 electric powered transportation
 solar powered transportation
 gas turbine inlet flow
 augmentation of freezing water by using an electric fieldt
 tensile testing of porous materials

Although the students had not finished their research, they wrote what they knew at that point as best as they could. They gave oral presentations as well, so oral skills were also practiced in the course.

3-3 compressible fluids course

The compressible fluid course was conducted as follows.

Week	content
1	Introduction to compressible flow-continuity, momentum, energy equations
2	1-dim flow, speed of sound, Mach number, normal shock relations
3	Oblique shock and Expansion waves
4	Area-velocity relation, flow through variable-area ducts
5	Flow through variable-area ducts with normal shocks.
6	Continuation of Week 5
7	1-dim flow with heat addition
8	1-dim flow with friction
9	Course review-preparation for final exam

3-4 Problems Identified

Terms and phrases students had difficulty defining are listed below.

1. adiabatic (flow)	12. friction factor
2. approach	13. hydraulic (diameter)
3. compressible	14. initial
4. decelerate	15. isentropic flow
5. direction of heat flow	16. isentropically
6. enthalpy	17. Normal shock
7. entropy	18. properties
8. expanded	19. Rayleigh line
9. Fanno, is this an abbreviated word?	20. static subsonic
10. flow over airfoils	21. supersonic
11. friction	22. total (stagnation) properties
12. friction factor	

Eighteen students including graduate students, registered for the course. Some students also

*“Proceedings of the 2002 American Society for Engineering Education Annual Conference & Exposition
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took the Technical Report Writing course at the same time. At the interviews, they commented that although the content of the Compressible Fluid course was much more advanced, they had an easier time understanding lectures due to mathematical nature of the subject. Nevertheless, both courses seemed to complement and to benefit them.

4 Discussions and recommendations

Eighteen senior engineering students started the Technical Report Writing course and fifteen completed both the oral and written parts. The subjects they choose were listed earlier. Of the eighteen students that started the Compressible Flow course, all finished with a grade of at least "B". The latter course was much easier for the students since it was mathematical. The students did have trouble with symbols and some technical words. For example, the words "Fanno" and "Rayleigh" were particularly troublesome. It was difficult to explain, in English, that these were only names of curves and had no other meaning. "Upstream" and "downstream" were also hard to explain in English. One of the rules of the course was that only English would be used. (pronunciation/stress problem – the students know the word, but couldn't comprehend it. Benefit of having native professor is to learn correct pronunciation, stress, and variation of expressions.)

One of the most surprising results of the writing course was the use the students made of their former English teachers. KIT students are not known to visit professor's offices often. But they did use this resource to help in writing their reports. This pleased the authors as well as the English teaching faculty.

Another positive result of the courses were statements made on the course evaluations indicating that these courses had opened their eyes as to why they should study English. If they had known earlier of the use they could make of their English skills, they would have worked harder in their English courses.

KIT should continue offering the course in Technical Report Writing. Since it is very important that graduate engineers be able to read and write technical reports in English, the course should be taught in English. Since this requires a visiting professor, he/she could also teach a graduate course in his/her field. Presently, a professor from Rose-Hulman Institute of Technology is planning to be at KIT during the Fall quarter 2002 to continue the work started in 2001.

When the courses are taught again, there should be handouts, in Japanese, explaining the technical terms students have found difficult to understand previously. In addition, course outlines and list of symbols should be provided, in Japanese.

Several students suggested that the preceding English class should be offered before these two courses so that the transition from courses in Japanese to English will be easier. A class should be conducted to learn important words, such as survey, discussion, and friction. The terms need to be defined in context.

The course should be expanded to 4 quarter credit hours allowing for more time for in class work sessions.

The professors at KIT who feel English is important to the graduate engineers should continue to impress this fact on the administration and the students.

5. conclusions

Through our attempts to teach the two technical courses in English to Japanese students, we have identified several problems and methods to remedy them. It is our hope to improve the content and teaching methodology and to be able to continue offering such courses.

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