Integration of English Language Modules into the Introduction to Engineering Design Course in the Vantage College 1st Year Engineering Program at the University of British Columbia

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Abstract – Vantage College at the University of British Columbia (UBC) offers a unique undergraduate first-year program to international students, built around the integration of English language education with academic degree-focused courses. The particular emphasis of this program is on creating an effective learning environment for students with varying levels of English language proficiency and diverse cultural backgrounds. In the engineering design course, which demands a high level of student engagement and collaboration, this Academic English support in an adjunct course is tailored towards the improvement of presentation skills, verbal and written literacy, and group work. This paper provides an overview of the partnership between the engineering design course and its linked language-enrichment course. Some of the language-based practices are described and their successes are evaluated based on observations and student feedback through a survey. The overall student response on the effectiveness of language activities is found to be positive and oral presentation exercises are considered to be particularly helpful in improving the students' experience in the design course.

Keywords: Engineering Design, English Language Education, International Students, First-Year Engineering Curriculum, Communication, Student Engagement, English for Academic Purposes, CLIL

1. INTRODUCTION

A lack of English language proficiency is known to be one, if not the greatest, barrier experienced by international students [1-3]. Language difficulties not only affect international students' academic performance, but also often hinder the interactions and engagement with their peers. Linguistic challenges may be especially distressing for international students with high academic

achievement in their home countries, and can, in turn, negatively impact their psychological adjustment.

With the growing demand for globalization and international education [4], significant effort has been made in attracting international students to engineering programs in Canadian universities. Many of these international students, however, face academic difficulties due to language and cultural barriers, in spite of their strong technical background. It has been shown that international students particularly face challenges in courses with emphasis on conversational English and classroom participation [5]. Hence, one would expect that the negative impact of linguistic gaps on the performance of engineering students would become further pronounced in engineering design and project courses, where student engagement and collaboration, group work, oral presentations, writing reports, and class discussions are key elements of the course.

The mandate of the Vantage College is to assist international students with strong academic competencies in discipline specific curriculum but insufficient English language capability to adapt to required university-level instruction standards at UBC. This is addressed by providing 11 months of intensive first-year discipline specific instruction (in Arts, Science, Engineering and Management) combined with English language support in the Academic English Program. Students who successfully complete the Vantage College program qualify for a second year standing in their respective faculties at UBC.

Vantage College Engineering Stream is a fully integrated first-year engineering program which is comprised of relevant mathematics, physics, chemistry, and introduction to programming courses as required for accredited engineering programs. These courses are all tied with additional English language, content based support. In addition, students are required to complete 6 credits of English language courses, an engineering

communication course and introduction to engineering design.

Our experience shows that international students may have significant difficulties grasping the engineering design terminology, which may, in turn, significantly affect their ability to comprehend the materials covered in these courses. Although several methods and approaches have been implemented in North American universities to help the international students overcome language and cultural barriers [6, 7], no previous work, to our knowledge, has specifically addressed the obstacles faced by first-year international students in engineering design courses.

This paper provides an outline of a pilot project for integrating Academic English instruction with a first-year engineering design course. In this approach, in addition to attending the course lectures and tutorials, students participate in a series of language-based modules, closely linked to the design course topics, but aimed at developing their communication skills and group interaction. In the following sections of this paper, the nature of the language-focused modules, examples of activities and practices, and their model of delivery are presented. The impacts of these integrated learning activities on the performance of students in the design course are discussed and a summary of the results is presented.

2. METHODOLOGY

Sustainability and Engineering Design, VANT150, is a first-year course with focus on the introduction of principles of engineering design, project based learning, and sustainable engineering practices. Learning outcomes for this course include general understanding of engineering systems and their interaction with emerging global issues, understanding of communication paths between stakeholders, and application of the engineering design process, such as the transition from the identification of the problem statement, through different stages of conceptual to final design, to well-defined engineering design problems. Most of the work is carried out by student design teams in the form of group assignments and mini projects. The inherent language obstacles to reaching the learning outcomes are addressed by providing additional language instruction in the corresponding English for Academic Purposes (or EAP) course.

The EAP courses at Vantage College, UBC, are designed to run parallel with their disciplinary content courses. Through such adjunct courses, this EAP instruction provides the linguistic support needed for international students to deal satisfactorily with the credit-bearing programs of their specialization [8]. Since the

EAP teaching is based on Systemic Functional Linguistic (SFL) principles, the communication of meaning is central. This implies that the teaching focuses on helping the students to express themselves appropriately and accurately in and for academic tasks (which is very different, for instance, from the old-fashioned and traditional teaching that focuses on the correct forms of grammar at the expense of meaning and context). Running concurrently, the EAP adjunct courses and their disciplinary counterparts are closely connected, with, for instance, EAP instructors attending content courses and vice versa. In this particular case, the engineering-language tandem courses consist of the Engineering Design course at UBC, with a one-hour lecture and a one-hour tutorial every week, and a weekly, one-hour adjunct course in EAP, called VANT140. Sections in the English classes are relatively small, with a maximum of 25 students, which facilitates pair work or group work to practice a given skill.

3. LEARNING ACTIVITIES

For the English classes the entire engineering cohort is divided into 4 relatively small sections of 20 to 25 students each. The EAP learning activities always aim to incorporate active learning. Tasks, whether in-class or out-of-class, are varied and develop or reinforce skills required in the Engineering Design course. A brief description of some learning activities is given below. The described learning activities which, upon observation of student success in the previous year, take priority in this pilot project include: Oral Presentation Practices; English Cause-Effect Practices; Technical Vocabulary Practices, Short Reading Practices and; Academic Vocabulary Practices.

3.1 Oral presentation practices

One of the aspects of an engineer's career, of which most international students seem to be unaware, is the frequent need for oral presentations. Considering that international students usually lack the fluency and confidence to speak about engineering topics, the EAP course has incorporated regular oral practice. Talking in pairs or small groups was practiced in the VANT140 weekly sessions. One type of oral practice in English was closely related to an assignment in the content course, dealing with an engineering failure. For the Engineering Design course, an example of this topic was chosen and researched by small groups and described in writing, but it was also adapted for the EAP assignment. The same engineering failure case – be it the Titanic, the Hindenburg, the Samsung phone or any other instance

chosen – was first practiced in the EAP class through small group presentations. Next, each individual student had to prepare an oral presentation of the failed project in a video clip, which had to follow a number of prescribed stages (for example, the need for the engineering project, the approach, the design weaknesses, the consequences of the mistakes and the lessons learned). This video-recorded presentation was evaluated, not for the content of the engineering project, but for aspects of oral performance. The rubrics utilized were the stages of the presentation, clarity of description, rapport with the listener, comprehensibility (such as pronunciation, intonation, word stress, pace and tempo) and adherence to assignment instructions.

3.2 English cause-effect practices

One quintessential function in Academic English relates to the expression of cause and effect. Low-Beginner level English teaches the simple conjunction “because” followed by a clause containing the cause. In order to expand on this, students need to learn and use not only other conjunctions with clauses, such as “since” and “as”, but also other expressions. These alternatives include prepositions followed by noun phrases with causes, such as “because of”, “due to” “owing to”, “as a result of” or “on account of”. They also include sentence connectors of effect, such as “therefore”, “consequently”, “as a result”, “thus” and “hence”. Students also need to expand their knowledge of cause-effect verbs, for instance, “to cause”, “to bring about”, “to contribute to” or “to account for”. This entails some understanding, practice and use of opposite meanings, so that they can distinguish between “to cause” versus “to be caused by”; or between “to result in” versus “to result from”. To practice this cause-effect function, a short text given at the beginning of class dealt with some devices in a car that can distract the driver and therefore contribute to a traffic accident (for example, cell phones or GPS navigation systems). First, groups of students had to come up with as many cause-effect expressions as possible, and then classify them according to their grammatical form. Next, they wrote their expressions on the board in different grammatical categories. Corrections were then made with the whole class guided by the teacher. Finally, students could paraphrase parts of the text using a variety of cause-effect expressions.

3.3 Words for shapes (sub-technical vocabulary)

The lessons on the vocabulary for shapes were organized on the basis of two experiences. First of all, it was clear that many international students had missed some references to shapes during an engineering design lecture about drawing (“isometric”, “dash-dot-dot line”);

but also one of the lecturers requested to incorporate words for shapes in the EAP course, after she had discovered during an exam that many students could not answer the test item that contained the word “cylindrical”. The EAP lecturer then designed a couple of lessons to cover this semantic field, the first lesson containing 1-dimensional and 2-dimensional shapes (e.g. “diagonal”, “oval”, “diamond-shaped”, “hexagon”, “crescent”), and the later lesson teaching 3-dimensional shapes (e.g. “cone”, “cylindrical”, “hemisphere”, “tetrahedron”, “wedge”). To check which words were familiar and which were not, a simple exercise was done in class. Each student was given a large sheet of paper to draw the shape that the instructor dictated, with a total of about 30 words. Then students could consult with each other for peer help, after which the instructor dealt with the new words. The structure of this lesson was the same for the 1- or 2-dimensional words, as for the 3-dimensional words. To make sure that the vocabulary was reinforced, the students had to show in a quiz that they remembered all the shapes, for instance, by describing the flags of 4 countries (Greece, Tanzania, Malaysia and Tunisia).

3.4 Short readings

The general theme of sustainability and renewable energy in the Engineering Design course was integrated in the EAP course in order to give the students much needed skills practice, such as reading the difficult genre of academic writing. It became clear that they even needed extra practice with non-academic, and therefore more accessible genres of reading and speaking. For this purpose, some short articles about different experiments and projects related to alternative energy were selected for class use. A small number of popular scientific articles was distributed in class using the so-called jigsaw technique, whereby a group of students received the same article and, after reading it, had to discuss its contents. Next, everyone was assigned a new group of different peers all with different articles and, in turn, had to give the new group members a short, oral presentation about the content just read. This exercise offered the practice of talking in a small group, rather than the more daunting and nerve-wrecking task of addressing a much larger audience. Presenting students received immediate feedback from either the EAP or the Engineering instructor, both of whom rotated through the class.

3.5. Academic vocabulary

Engineering students need to develop the skills to acquire any necessary vocabulary, be it of the general, the highly technical or the sub-technical type. When given a textbook chapter on the engineering profession, many of our international students showed a lack of reading

comprehension based on their unfamiliarity with frequently occurring academic words. In order to devise an assignment for the students to learn specialized vocabulary, unknown words were extracted from their textbook readings. All these words belonged to the so-called Academic Word List (or AWL). Each word was assigned to one student, who had to investigate it with the aid of dictionaries and record its 12 different aspects, such as its meaning, pronunciation, part of speech, and use in an example sentence. After each student's information about a given vocabulary item was revised and corrected, the words with their 12 aspects were then collected for the creation of a collaborative class wiki. This task stressed the importance of adequate dictionary skills and a raised awareness level of a particular word's collocation patterns. Once the collaborative wiki was finalized, a written test was given to make sure that the students had learned all these AWL items and could use them in a variety of contexts.

4. RESULTS AND DISCUSSION

4.1 Student Feedback

An anonymous course exit survey was conducted at the end of the second term to obtain students' feedback on the learning activities performed during the language-based tutorials and seek their input on potential improvements for the future. As part of this survey, students were asked to what extent they agreed with the effectiveness of the language-based practices outlined in the previous section.

The results (collected from 53 out of 80 students) are demonstrated in Figure 1. The green, red, and blue colors indicate the percentage of students who agree (or positive), neither agree nor disagree (or neutral), and disagree (or negative) with the helpfulness of language-based activities, respectively. For all 5 learning activities, more than half of the students agreed that the EAP practice had been effective in improving their performance in the design course. Considering that this was the pilot year for such partnership between the design and language course, these results are very promising. Also very encouraging is the fact that only a small percentage of students (4% - 8%) disagreed with the benefit of such practices.

Based on this survey, it was found that students particularly appreciated the oral presentation practices. This was reflected in the collected data (more than 70% in agreement), as well as in the comments provided by the students in the survey. Most students indicated that they greatly benefited from the presentation practices to better prepare for oral presentation assignments of the

engineering design course, with some expressing special appreciation for small-group presentations, which gave them a chance to exercise and improve their skills in an intimate setting.

Fig. 1. Student Rating of Effectiveness of Language Activities

Several students also commented on how other English-based activities helped them with specific design course assignments. For instance, short reading practice was mentioned to be helpful in reading and understanding sustainability-related articles, while vocabulary and grammar exercises were indicated to improve the quality of their writing for creating posters.

In the "suggestions for improvement" section of the survey, many students expressed the need for more oral presentation exercises during language tutorials, and some suggested practices that involve presenting to the whole class, in order to simulate the same presentation atmosphere as in the actual oral presentation of the design course. Some students also asked for adding more modules on engineering vocabulary and readings.

4.2 Student Performance

The students' presentation skills were compared during two major assignments of the design course that involved oral presentations. The first one was an oral presentation on alternative energy sources and the second one was a poster presentation on sustainability. For the majority of the students, a significant improvement was observed in the delivery of the second set of presentations

compared to the first one, which in our opinion, can be attributed mainly to a series of presentation practices that were implemented in the language tutorials between these two design course presentations. A quantitative measure of the improvement could not be achieved, as the setting and nature of the two presentations were different. To better gauge the success of our language modules, presentations activities that run in the same setting and are evaluated with the same rubric, will be designed for subsequent years in order to attempt a direct comparison of students' presentation skills before and after the presentation practices.

5. CONCLUSIONS AND FUTURE WORK

Integration of language-based modules with our first-year engineering design course is considered to be successful in improving the performance of international students in the course. Students reported improvement in their oral presentation skills, writing, and reading comprehension as a result of these modules. Assessment of students through different course deliverables also confirmed the effectiveness of these practices. The English-related activities described in this paper create a solid foundation for designing more diverse language-based tutorials in the future. A systematic way for comprehensive evaluations of the effectiveness of the practices will also be implemented. Successful integration of academic-English instruction with engineering design courses has global implications on teaching effectiveness and intercultural education across all engineering disciplines.

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