Introducing Humanities Aspects through English Language Teaching in Engineering

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Abstract – **Contemporary engineering curricula increasingly include mandatory courses which have traditionally belonged to the humanities such as ethics, academic writing, or communication skills. This trend toward shifting the emphasis away from strictly technical and mathematical content was prompted by what assessors in both industry and academia have considered some lack of competence in engineering graduates, particularly in relation to communication skills. For educators, the challenge to include such courses in the engineering curriculum involves how to tailor them to the needs and interests of engineering students, and how to optimize their relevance while maintaining the valuable humanities aspect. An English language course, a part of many engineering curricula throughout the non-English speaking world, provides a unique venue where many issues in humanities may be integrated into the English language course content. Authentic materials in the areas of professional ethics, academic abstracts and articles, case studies, on-line video clips, and essays provide the basic texts from which students can study both form and content. These materials may be covered in the classroom or online – through the language centre, or at the language centre. Such is the case at the Technical University of Crete where English language courses comprise authentic content, but are discussed and explored from the humanities perspective.**

Index Terms – engineering education, English for specific purposes, humanities and engineering

1. INTRODUCTION

At least one course from the Humanities is today among the required undergraduate courses in a significant number of engineering schools around the world. The topic of such a course usually relates to writing or language communications. The Massachusetts Institute of Technology, Stanford University, and the University of California at Berkeley are examples of institutions wherein at least one writing or language communications course is included in the undergraduate curriculum. Furthermore, many universities have Writing Labs with tutors and resources available to students who need help or advice. Some schools go so far as to have Online Writing Labs (OWLs), such as the one at Purdue University or Rensselaer Polytechnic Institute offering handouts, exercises, and assistance with grammar, punctuation, essay or report writing.

In large part due to published surveys and reports that have emphasised the inadequate level of writing and communication skills in engineering graduates, there has been a move to embed the enrichment of such skills into the engineering curriculum. The recently released Association of Graduate Recruiters biannual survey reports that many engineering graduates lack 'soft skills such as communication' and 'verbal reasoning' [1]. Ted Hissey reports that although industry executives, managers, and academics are pleased with the technical skills of engineering graduates, they believe many of them do not have enough soft skills, including written and communications aptitude. These potential employers look to educators to help amend the situation; they "…feel that universities can help students develop this skill by increasing the emphasis on writing clear and concise reports in undergraduate and graduate courses" [2]. The Graduate Outlook Survey 2006 places 'interpersonal and communication skills' (57.5 per cent) at the top of their list of criteria for the hiring of engineering graduates with academic qualifications (35.4 per cent) and work experience (37.6 per cent) following [3]. One thing is certain; employers want engineers who are adept at more than technical matters.

Potential employers are not alone in the value they place on communication and related skills. The Accreditation Board for Engineering and Technology Criteria 2000 states that engineering programmes must demonstrate that their graduates have "an ability to communicate effectively" in order to receive accreditation [4]. Fisher, Usrey, and Beasley point out that both The National Science Foundation (NSF) and the Boyer Commission in the United States recommend the improvement of communication skills in undergraduates [5].

The acquisition of good communication skills for engineering students is, of course, international in nature. We may assume its importance irrespective of language. Greek engineering students, it is assumed, should have competent communication and writing skills in Greek, German engineering students in German, Portuguese engineering students in Portuguese and so on. However, beyond the requirement of language competency and communication skills in a student's first language(s) are the advantages of foreign language acquisition.

Foreign language proficiency, particularly for engineering professionals provides an invaluable tool in the

world's increasingly inter-cultural, cross-border, and global-market environment. In discussing the implications of the global market on English and communication skills for engineering graduates, Riemer states that "Globalization directly influences industry's needs; a global engineer must be able to easily cross national and cultural boundaries" [6]. Foreign language learning can not only expand the practical qualifications of the engineering graduate but also develop a multi-cultural awareness of other environments and increase a sensibility to the social context of the engineering domain.

In this paper, the discussion focuses on two courses in English for specific purposes although it is assumed that the ideas offered here apply to the teaching of any foreign language.

The content of the courses can basically be categorized into two groups. The first group is comprised of a variety of practice exercises in selected areas of grammar, vocabulary, reading, and writing. The second group contains authentic materials, both written and audio-visual, which relate to the subject areas of the departments in which the courses are taught. In an environmental engineering course, for instance, materials range from up-to-date information from the European Environmental Agency (http://www.eea.europa.eu/) regarding the state of the ozone layer, to the awarding winning documentary, *An Inconvenient Truth*, presented by Al Gore.

Each of these materials would, of course, be exploited differently. The ozone facts may be part of an assigned information gathering task while the documentary could be the focus of a class discussion on the ethical responsibilities of environmental engineers within someone else's political agenda.

Working with authentic materials allows students to exercise methods of interpretation, speculation, and criticism. These resources and the educational activities associated with them can raise social and ethical awareness, which is a desirable benefit to the engineer as a professional and as a responsible social being.

The objectives of the English courses described below integrate the general characteristics of a course in English for specific purposes, such as those outlined by Carver, with instructional objectives appropriate to engineering, many of whom are in agreement with those put forward by Felder, Woods, Stice, and Rugarica [7,8]. The courses intend to:

- make their relevance within the context of the specific engineering curriculum clear
- promote the adoption of 'can do' goals for students (from the Common European Framework of Reference for Languages) via the language centre's main web links [9]
- encourage students to develop a self-directed approach to learning
- provide explanation and practice for the mechanical aspects of language; i.e. grammar, word formation, sentence structure, paragraph development, and so on
- engage students in the exploitation of authentic texts and/or audio-visual media in the relevant discipline
- provide formative assessment
- maintain a stable course environment irrespective of attendance records
- offer flexibility with respect to student's learning preferences or style, language level, and time

These objectives are tackled by utilizing three interconnected teaching and learning environments: an e-learning platform, the self-access language centre, and the traditional classroom. Each one and its relation to the objectives of the courses will be discussed in turn.

2. TEACHING AND LEARNING ENVIRONMENTS

The discussion that follows relates to two courses: English 04 in the Department of Production Engineering and Management (DPEM) and English 03 in the Department of Environmental Engineering (DEE). Both courses are taught at the Technical University of Crete, where engineering students must successfully complete four semesters of a foreign language, either English or German.

Each course combines a programme of self-access learning at the Language Centre with a series of work modules to be covered in class. In English 03 for the Department of Environmental Engineering, these work modules are for Environmental Education, Global Warming, Water Pollution, Wastewater Treatment, and Recycling. In English 04 for the Department of Production Engineering and Management, the modules are for Engineering Management, Business Process Re-engineering, Operations Research, Privacy and Technology, and Advertising.

Each module focuses on language, texts, and writing skills directing students' academic English competency toward a level high enough to allow its use within either an academic or a professional sphere. Semester assignments and quizzes throughout the course and a final exam determine the student's mark.

2.1 The e-Learning class

The e-learning platform used for the English courses mentioned above is a course management system (CMS) called Moodle, a free, open source software package [10].

The Moodle e-learning platform or e-class, as is referred to here, has proven to be propitious for a diversified population of students. Courses can be accessed through the web site of the Language Centre at the Technical University of Crete. (www.kegep.tuc.gr) and provide an online learning environment conducive to both self-directed and group focused learning.

a) The weekly schedule, demonstrated in figure 1, provides details of the course content. Students have reported that they value having a visual

organization of the course; it helps them to keep on track and understand its direction in terms of new knowledge acquisition. In this respect, it suits both the sequential and the global learner, as defined by Felder [11]. It provides a detailed weekly break down for the former and the overall scope for the latter.

b) The e-class offers a positive environment for the reflective learner who prefers introspection rather than active participation in an open classroom. Furthermore, for students who lack confidence, it provides an opportunity to practice language skills and receive feedback at a comfortable pace, allowing the gradual building of confidence needed for public interaction.

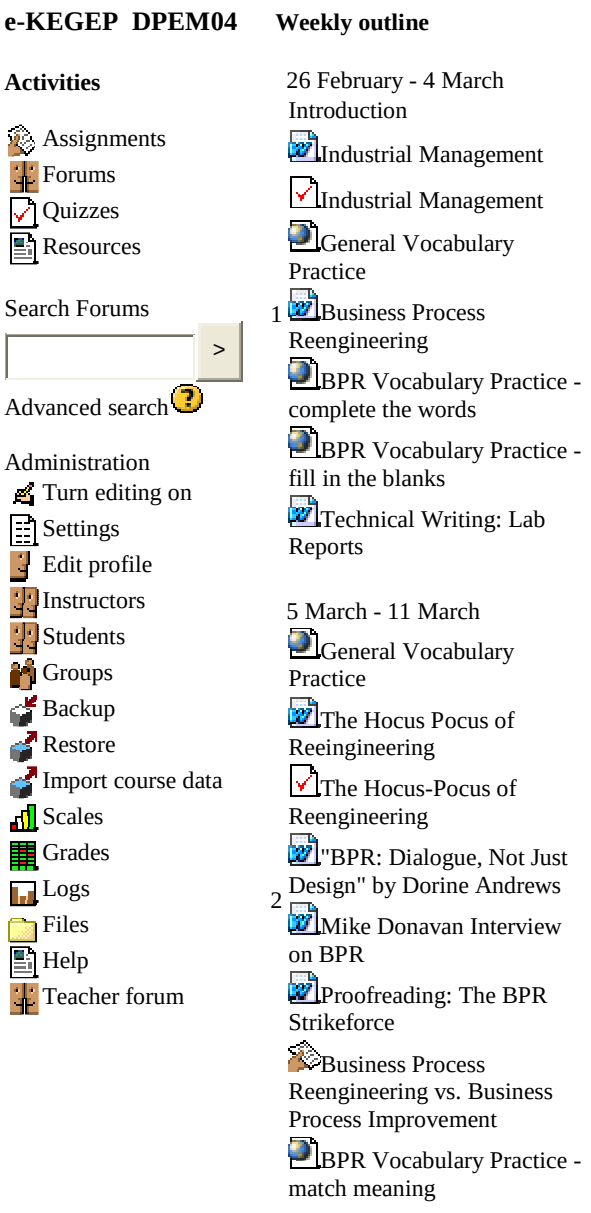

FIGURE 1. SAMPLE PAGE FROM PRODUCTION ENGINEERING AND MANAGEMENT ENGLISH 04

c) There are approximately 15,000 exercises from our website available online and many more links to exercises on other websites. The vocabulary exercises, such as those in figure 2, when corrected, (corrections shown in italics) provide more than a feedback score of correct and incorrect answers. Once the feedback score is available to students where correct answers are highlighted in bold, they may click on the word to check the meaning. An instant connection to an online multiple dictionary resource site, shown in figure 3, gives an immediate definition of the word, an example of how it is used and a selection of phrases in which the word is often found. In this sense, the exercises are designed to be formative in that they instruct rather than merely measure knowledge.

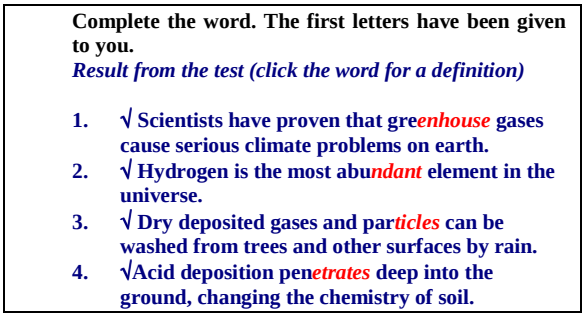

FIGURE 2. PARTIAL RESULTS FROM VOCABULARY EXERCISE FROM DEE 03

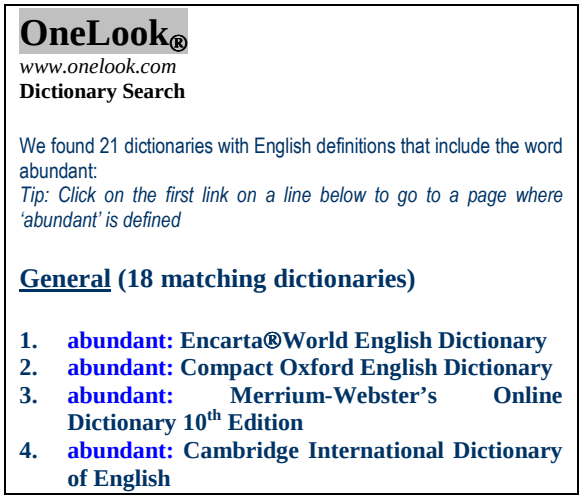

FIGURE 3. PARTIAL RESULT FROM DEFINITION SEARCH FOR 'ABUNDANT'

d) Online quizzes and assignments partially determine whether students have met the course objectives. They contribute to summative assessment, in this way, together with the final examination. However, they, too, are intended to be formative. Vocabulary quizzes usually offer three attempts per quiz and the best mark is taken as the final grade, as shown in figure 4. It is hoped that feedback on quizzes and assignments will help students to use reflective approaches of analysis leading to the development of strategies for new knowledge, a method usually employed in

the humanities but offering complementary benefits to the engineering curriculum.

Vocabulary Quiz: Advertising

Complete the words in the sentences. The first few letters have been given to you.

Attempts allowed: 3

Grading method: Highest grade

Time limit: 15 min

The quiz is available until: Monday , 21 May 2007, 11:55

FIGURE 4 VOCABULARY QUIZ INSTRUCTIONS FOR DPEM 04

Students are informed that vocabulary questions in the final examination will be drawn from the pool of exercises related to the course currently online. This information motivates students to practice; they perceive the course objectives as feasible.

Assignments include essay writing, film reviews, book reviews, information gathering, and evaluation tasks. These tasks are designed to maximize the students' exposure to issues or problems to be found in real world environments. There are limits, however. The language instructor's main purpose is to use texts and other media for the development of the target language. A language instructor is seldom an expert in the engineering field of his or her students. For this reason, material is chosen from within the topic area of the students' discipline but is accessible to the lay person as well.

Authentic materials of a broader nature, like those most likely to be chosen by the language instructor, lend themselves to discussions characterised by a humanities aspect. A few examples from English 03 DEE and English 04 DPEM illustrate this point.

The first example is from English 03 DEE. Students were asked to apply criteria put forth in an EPA pamphlet about quality environmental education, which had been covered in class, in the evaluation of children's online environmental education sites. See figure 5.

This task requires that students use English as tool within a real world context. It demands that students exercise methods of selection and evaluation. It also puts an emphasis on the need for social awareness of environmental problems, placing the student into the role of problem-solver.

A second example is an essay writing assignment that requires some research on the students' part:

Visit the site of the World Health Organization
www.who.int/water_sanitation_health/diseases/diseasefact/en/.

There is a list with a variety of diseases that can result from unsatisfactory water conditions. Look up one of those diseases and find out in which parts of the world that disease is currently an urgent problem. Focus on one community and report the local causes and effects of the disease. Make suggestions as to what is required to eliminate the threat of that disease in the community.

Here, once again students are asked to work with English at the same time as develop English skills. It is assumed that during the locating, understanding, and evaluation of information, students will expand their knowledge of English. In addition, they will gain the benefits of employing critical thinking skills so essential to the professional environment.

Evaluation of Environmental Web Sites

Using the scale below, rate the quality of the web sites given in the table based on the criteria taken from the EPA's pamphlet on Environmental Education. You can copy paste the table into the submission box and fill it in. In a paragraph following the table, explain which site you consider to be the best and why.

Scale

1 Poor
2 Satisfactory
3 Good
4 Excellent

Web Sites

1. Recycle City
www.epa.gov/recyclecity/
2. Kids Corner
www.ec.gc.ca/acidrain/kids.html
3. EPA Students Centre
www.epa.gov/students
4. Environment Canada's Ozone Page
www.ec.gc.ca/ozone/
5. World Wildlife Foundation
www.panda.org/news_facts/
6. United Nations Framework for Climate Change
http://unfccc.int/cop3/fccc/kids/kids.html
7. Planet Protectors Club
www.epa.gov/epaoswer/osw/kids/index.htm

Web Site	Real World Context	Learner Centered	Critical Thinking - Problem Solving	Inter-disciplinary Curriculum
Recycle City				
Kids Corner				
EPA Students Centre				
Environment Canada's Ozone Page				
World Wildlife Fund				
United Nations Framework for Climate Change				
Planet Protectors Club				

FIGURE 5. EVALUATION ASSIGNMENT FROM DEE 03

e) The e-class provides a flexible learning environment that encourages self-direction. Students vary in their learning strategies, in their levels of English language proficiency, and in the time they require to satisfy the demands of their courses. The e-class permits participants to choose how, and to some degree when, they prefer to participate in the course.

For example, students may want to repeat the practice exercises many times in order to achieve a perfect result in the online quiz of the week or they may decide to try the quiz based on their current knowledge to see whether it is necessary to do any of the practice exercises at all. The responsibility is the student's.

Students may also decide on the degree to which they should actively participate in the course. Some learners may feel that they need to attend every class. Others may feel that they can follow the course from a distance, read the notes, do the quizzes and assignments, and utilize only those materials they require to refine their language skills and meet the course objectives.

f) The e-learning platform facilitates direct links to a variety of up-to-date resources on the Internet. Authentic materials, from which language learners benefit, have long been established as an essential part of any course in English for special purposes.

In English 04 DPEM, there are several examples of how authentic texts are utilized to employ students' higher level skills of analysis, synthesis, and evaluation.

One of the activities dealt with in the classroom is the comparison of three articles about Business Process Re-engineering.: *The Hocus-Pocus of Reengineering* by Paul Strassmann, "BPR: Dialogue, Not Just Design" by Dorine Andrews, and *The BPR Strike Force* by Bill Roberts [12,13,14]. Each article shares similar terms and vocabulary for language reinforcement while addressing the same topic. Each one, however, presents a different point of view. By comparing the arguments presented by each of the three authors, students exercise both the English language and critical thinking skills.

Whether written texts or audio-visual format, authentic material can provide relevant topics, suitable vocabulary exposure and appropriate style for the discipline in question. They also place potential graduates within the 'real world' context of the engineering environment that they will face as professionals.

2.2 The Self-Access Language Centre

A self-directed learning environment in the real sense, the language centre provides an assortment of resources for students wanting or needing to improve their English language skills.

For each course, one meeting a week is given to in-class instruction. Students are then at liberty to exploit the resources at the centre, which include web-based activities, paper-based worksheets focused on reading, grammar, and vocabulary refinement, commercial multimedia packages, a video and DVD library, a small lending library of fiction, and an opportunity for one-on-one guidance or tutoring by an instructor.

Although much of the material is used in direct association with course syllabi, there are many resources from which students can choose according to their preferences. Some students feel comfortable with traditional paper-based worksheets, while other opt for the challenge of watching a film with or without English subtitles.

Within the centre, students are encouraged to examine their own language needs and are expected to carry out self-assessment, chiefly using the criteria set out in the Common European Framework for Reference of Languages.

2.3 The Traditional Classroom

As stated above, one meeting per week is scheduled for the traditional classroom. Despite the impressive offerings of online courses, the traditional classroom still has its place. Students here can participate in group discussions on topics requiring, assessment, judgement, and debate. Authentic materials take the lead here. The social consequences that result from a policy decision might be examined. The moral dilemmas that engineers may find themselves in as professionals are discussed. In this environment, students are expected to use English as a tool to communicate and understand. Materials at the language centre and those in the e-classes should provide the students with the weekly preparation they need to make the most of classroom meetings.

3. SUMMARY AND RECOMMENDATIONS

While the goal of any English foreign language course is to enhance the competency of the students, more ambitious goals may be set for courses in English for specific purposes with respect to engineering.

Instructional objectives need not be limited to strictly those of language acquisition. Goals such as improving student aptitude in methods of analysis, interpretation, speculation, and criticism can be interwoven into the course through the use of authentic materials.

Furthermore, courses designed in conjunction with e-learning platforms, such as Moodle, and self-access language centres promote self-directed learning and autonomy, an educational bonus for the prospective engineer.

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