Poster Presentation

Science English/Lab – a Hybrid-Type Course in Entry-Level Scientific and Technical English for STEM Majors

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This paper outlines a 'semi-ESP' course delivering basic scientific/technical English for 1st year engineering undergraduates at Kochi University of Technology (KUT). Course content is introduced through a hybrid of paper-based and digital media and reinforced through practical project work. Primary objectives for the course are to mediate between what KUT learners can do with English when commencing their university studies, and what they eventually need to be able to do with English as engineering graduates.

In Japan, science and engineering undergraduates often matriculate with only a limited proficiency in general English. Finding ways to mediate between their levels of competence at entry and departure points on content-focused English Language programs is therefore an ongoing challenge for curriculum designers at many engineering colleges. At some colleges the solution is to provide an entry-level course focused on developing "common-core skills" in scientific and technical English (Dudley-Evans, 1997). Such courses are often labeled 'semi-ESP' because they do not fit comfortably within the traditional parameters of ESP. Neverthless they exemplify an idea that is central to ESP: that there will be different solutions to the problem of matching course design and approach to students needs.

Several approaches to teaching semi-ESP have been reported in the literature (Nakamura et al, 2004; Al-Busaidi, 2014). This paper describes a semi-ESP course that is used for 1st year engineering undergraduates at Kochi University of Technology. This course combines a project-based methodology with a 'hybrid' (Garnham and Kaleta, 2002)means of delivery. In the first section of this paper the principal features of the course are outlined. This is followed by a brief overview of the main pedagogical theories supporting project-based learning and e-learning, and a summary evaluation of the course in meeting learner needs. The concluding section begins with a summary of findings, ending with some comments on future trajectories.

Syllabus Overview

Currently, the KUT course has two components, Science Lab (SE) and Science English (SL), which are taught over consecutive eight-week quarters in twice-weekly sessions. Six native speaker (NS) instructors teach the course to 11 separate mixed groups of ~35 students.

The course syllabus is a multi-syllabus encompassing functional, task-based and grammar elements. Content is delivered via textbook (Daniels, P. 2013. *Science English: Communication Skills for Scientists and Engineers*), Apple IPods and a Moodle Course Management System (CMS)-based e-learning environment. All course materials are produced by the course administrator, although some programming work for digital content is outsourced.

Throughout, the focus is on 4-skills work that aims to build a foundation of knowledge in the basic descriptive structures used in scientific discourse. The hope is that learners will then be able to revise and extend this knowledge in 2nd, 3rd and 4th year elective courses, and in the graduate level 'Technical Writing' courses. The means by which they acquire this knowledge is by firstly doing textbook/IPod-based language-learning activities in the classroom, then applying the language learned to complete a series of lab-based projects. In this way, scaffolding in grammar and vocabulary provides pre-task preparation for the assessed project work.

The six main units in SE/SL (Tables 1 & 2) are structured around individual, pair and group writing, speaking and listening activities (question/answer, information exchange, gap fill etc). In each unit, text-based language activities are reinforced through IPod based activities (flashcards, vocabulary quizzes, listening quizzes). Each unit concludes with a unit mini-project, and a test. In

Table 1
*Syllabus Outline, Science English Component**

Science English (Weeks 1 – 8)		
Unit	Themes & Content	Lab-based project
1. Describing People and Places	**(S) Personal bios**: Age, occupation, hobbies, family, interests etc **(L) Cloze ex**. Bill Gates/Steve Jobs bios **(S)** Personal back ground (pairwork) **(W) Hometown Data:** Location, Population, area, pop. density, climate, topography, industry, local specialities etc.	**My Hometown** Learners… a) Create a Powerpoint presentation describing their hometown. b) Present to a small group of their peers. c) Record presentation with IPad
2. Numbers and Units	**(L) Numbers:** Ordinal, decimal, fractions and percentages. **Cloze ex:** *Cars in America* **(W) Units of measurement**: Area, volume, speed, mass and density, electricity, length and distance, energy **(W) Symbols**: Math and URL **(S)** Making estimations (pairwork) **(W) Machine** specifications	**Measurement and Estimation** Learners… a) Listen to audio files via Moodle to complete information gap activities. This information allows them to b) Answer questions about resource use. c) Complete measurement tasks (e.g the volume of a box, or the weight of a coin, the power consumption of a light bulb). d) Solve more complex problems, such as the savings one can make by converting from incandescent to fluorescent lighting (number of points awarded equates with the complexity of the question).
3. Describing Shapes and Dimensions	**(W) Shapes**: 1D, 2D & 3D shapes. **(W) Dimensions**: Length, width, height, diameter, circumference, radius, area **(L) Cloze ex**: IPod: Features and Functions **(W)** Estimate or Meaure **Mini-project**: *Describing the appearance of an object*	

*(L) Listening activity, (S) Speaking activity, (W) Writing activity, (R) Reading activity

Table 2
*Syllabus Outline , Science Lab Component**

Science English (Weeks 9 – 16)		
Unit	Themes & Content	Lab-based project
4. Describing Materials	**(W)** Matching object and material **(L) Cloze ex**: The general categories of materials **(R)** Materials comprehension **(W)** Made of or made from? **(W)** Describing objects **(W)** Combing sentences	**Product Description** Learners... a) Make a PowerPoint presentation describing a product they have researched. b) Present to a small group of their peers.
5. Describing Functions	**(S)** Functions crossword pairwork **(L) Cloze ex**: Robots and their abilities **(W)** Robots comprehension **(L) Cloze ex**: Inventions **Mini-project**: *Our Robot*	
6. Time, Frequency and Amounts	**(L/W)** Jim's/My daily schedule **(W)** Time prepositions **(W)** Writing questions about schedules frequency phrases **(S)** Pairwork: *Your typical day* **(L)** Cloze ex: Mobile phone use **(W)** Survey question structure	**Survey** Learners... a) Draft a 4-item survey on resource use. b) Collect data from their peers c) Make an Excel-based survey using data.

*(L) Listening activity, (S) Speaking activity, (W) Writing activity, (R) Reading activity

lab sessions, students recycle language via individual/group projects, which also incorporate listening, speaking and writing activities.

Discussion

SE/SL is now in its tenth year of service and to date approximately 4000 students have completed the course. The following section discusses its successes and shortcomings.

The SE/SL design draws on several aspects of cognitive development theory, most importantly the social constructivist ideas supporting project-based learning and e-learning introduced by psychologists Lev Vygotsky (1987), Jean Piaget (1970), Seymour Papert (1973, 1980) and David Jonassen (Jonassen, Carr, & Yueh, 1998;Jonassen & Carr, 2000). To add to this theoretical base, the designer brought his knowledge of pedagogical research, practical experiences of teaching language learners, and personal educational experiences. As the course continues to evolve, the objective will continue be to provide content that can mediate between EGP and ESP, and which is comprehensible, meaningful and motivating for low-proficiency learners from different disciplines.

With regard to the project-based approach that has been adopted for SE/SL, Dudley-Evans (1997) suggests that for content-focused courses such a methodology is "especially appropriate". One reason, he suggests, is that it is "motivating for students to be in work or study related groups and to study material that in some way involves their specialist interest", as this will produce "more efficient and effective learning." He reasons also that "ESP is most effective when it makes use of the methodology that learners are familiar with"; therefore, "if learners are studying or working in engineering the ESP course can make use of the problem solving methodology of engineering" (Dudley-Evans, 1997, p. 5).

In this context, the project-based methodology has proven to be generally successful in both encouraging students to take a more active role in and in giving meaning to their language studies. This has been confirmed by the generally positive feedback provided by mid- and end-of term surveys, and comments by SE/SL instructors.

On the other hand, for some students a proactive approach to learning can be somewhat unfamiliar. Because they are accustomed to a highly formalized, passive (teacher-led) style of learning, the need to adapt to the more independent style of learning expected in project-based work can be challenging. Also, as summative evaluation is the norm in most Japanese language learning contexts, the SE/SL method of formative assessment based on a series of smaller projects must be clarified from the outset. Finally, experience has shown that group-based tasks can sometimes marginalise learners with weaker language skills, pressuring them to take a passive role in the learning process.

E-learning, the other major facet of the SE/SL design, is an area of language education which has generated considerable interest over the past two decades. As discussed in the above, the theoretical foundations for SE/SL lie in the social constructivist ideas pioneered by Vygotsky and Piaget. Advocates have since used these theories to argue that technology can help to create an effective learning environment for the "computer generation" by encouraging a pro-active approach to learning, and improving "students' and educators' self-regulation skills, in particular their metacognitive skills." (Vovides, Sanchez-Alonso, Mitropoulou, & Nickmans, 2007, p. 64).

However, there is sometimes a danger that 'clever' delivery can detract from the priority, which is to provide quality content. In SE/SL, learning technology has been used to good effect because it has been considered a means rather than an end in itself. On balance, the online component seems to meet many of the requisites for an effective e-learning environment. It scaffolds the students' autonomy, and encourages their initiative for managing personal learning processes (Vovides et al., 2007) through learner-centred activities, and by emphasising system interactivity. From an instructional perspective, using a CMS as a delivery platform permits a dynamic approach to course development in which adaptations and changes can be made as necessary, bypassing traditional publishing channels (Daniels, 2008). It also allows instructors to provide quick feedback, and to administer large classes more easily.

Inevitably, some issues remain. For one, providing students with ready net access during classtime can detract from focus. Secondly, learners often use web-based machine translations when preparing texts, unconscious to the fact that these are error-prone. Information Technology (IT) aptitude among students is variable; basic computing skills sometimes need to be taught and this has the potential to impede progress. IT aptitude among teaching staff is also variable and basic administration skills often need to be taught; currently, only the course administrator has necessary IT skills to perform essential administration tasks. Problems including data loss and hardware damage occur as a matter of course. Furthermore, developing and maintaining the online component of SE/SL is costly, in terms of outlays on consumables, programming costs, and maintenance. All these issues must be accomodated. However, currently the biggest issue is that even 'semi-ESP' depends on a basic proficiency, without which "no further construction can ever be erected" (Viel, 2002, para. 4); in recent years there has been an apparent decline in English among the undergraduate population, and even this 'entry-level ESP' can be a challenge for some learners.

Conclusion

Currently, there is 'a broad consensus that (Japanese) engineers should have a good command of English' (Okamoto, Yamamoto, Dan, & Fuyuki, 2007). However, while engineering colleges should provide students with opportunities to build language skills, practicalities often dictate that this must be a linear process, beginning with a 'semi-ESP' course. To date course developers have taken several approaches to the challenge of designing such courses. The innovative approach that was described in this paper, in which basic scientific language is introduced through a combination of paper-based and digital media within a project-based learning framework, seems to be largely successful in addressing that challenge.

Notes

1. See also *Science Challenge – a hybrid-type semi-ESP course at Kochi University of Technology*. Paper presented at 3rd Annual JALT CUE ESP Symposium – Kanto 2014. (www.kochi-tech.academia.edu/MikeSharpe)

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