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High-Quality Language Teaching for Engineers Based on Integrated Language Acquisition*

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The authors explain how it became clear to them, as a result of regular staff and student exchanges with mainland European universities, that knowledge of foreign languages per se *was not enough for engineers wishing to work in mainland Europe or in European multinational companies: good language knowledge had to be coupled with the ability to communicate at the right engineering and social level both with their hierarchically opposite numbers and with company staff at all levels of a hierarchy. The authors then describe how the views of sponsoring organizations on course design and course content were gathered and how they developed a three-tier approach to language development and communication training, with the emphasis on integrated language acquisition, as follows: (i) language training—the tuition aims to increase accuracy of expression and correct use of language while also stressing fluency; (ii) language acquisition—this consists of engineering course elements such as product design or operational research taught in the foreign language; it also includes placements and periods of study abroad; (iii) communication and awareness training—by continuous contact with German and French professional engineers through the running of labs in the foreign language and placements on the continent the students' approach to engineering is 'internationalized'. The advantages and achievements of such an approach are presented and its possible drawbacks are examined in the light of substantial experience.*

BACKGROUND

STAFF in the Language Centre and the Department of Manufacturing and Engineering Systems at Brunel University, home to the Brunel Manufacturing Engineering (BME) and Special Engineering (SEP) programmes, have long had substantial experience of engineering culture in France, Germany and Switzerland. Well-integrated language options have always been an important feature of the programmes and have attracted between 20 and 25% of students in any one year. Regular staff and student exchanges helped develop an understanding of the similarities and differences between the engineering approaches in mainland Europe and Britain. While there has been a strong tradition of British engineers working overseas, from building railways in Argentina to developing oil fields in Saudi Arabia, Europe has proved a more difficult terrain for British engineers, who are faced with an established engineering culture markedly different from the one existing in Britain. As pointed out by Crystal [1], 'by no means everyone in the world knows English well enough to negotiate in it' and it was felt, therefore, that young engineers able to 'bridge the gap' could make a major and valuable contribution to the performance of international companies in Europe. This need for increased competitiveness through multilinguism has since been the main justification for many engineering degree courses involving a foreign language [2]. Traditionally such courses were developed as engineering courses with a parallel language class where the aim was to develop conversation skills in the foreign language, perhaps with the exception of the integrated BMEL course. Although useful, the traditional approach did not appear to be suited to students closely involved in practical engineering as part of the thin sandwich model of education.

Although the level of foreign language penetration in many UK companies is still very low [3] many industrialists showed interest in new ideas, and a working party was assembled involving Dowty Group, Ford, GKN, Michelin, L'Oréal and staff from Brunel. The views of the industrial organizations on course design and course content were gathered and a set of objectives was developed. These are listed below.

- Graduates of BME with French or German and SEP with French or German must achieve a high level of fluency in the foreign language for everyday purposes.
- They must be able to operate as responsible engineers at an appropriate level of fluency in the foreign language.

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- They must become fully aware of the engineering approaches prevalent in mainland Europe and the sometimes different approaches adopted in Britain.
- Finally, they are expected to be able to understand and use to their advantage the European industrial culture.

Following intensive discussions and preparations, BME with languages has been in operation since the academic year 1990/91, following pilot courses in 1989/90. SEP with languages was launched in 1992/93.

OVERVIEW OF THE COURSES

Students on the four-year thin sandwich BME with French or German Programmes and SEP with French or German Programmes not only *work and study* abroad as an integral part of their course but also take classes taught in French or German to improve their technical communication skills. There are three sectors/areas of language involvement: language training, language acquisition and communication and awareness training. These three elements are described in more detail below.

Language training

'Conventional' classroom and electronic media-based learning of the foreign language form an important element of the four academic periods of the thin sandwich course. This includes a one-week intensive language course before the start of each autumn term. The tuition is aimed at increasing the accuracy of expression and correct use of the language with some bias towards business, technology and scientific communication. In general, two hours per week of classroom activity is timetabled for this.

Language acquisition

Engineering course elements are taught in the foreign language. This is perhaps the most critical success factor in Brunel's approach, in that each week two hours of formal technical teaching is conducted in the foreign language.

The students in the first year of the 'with languages' programmes are doing part of the 'Product Study' project in the foreign language. In this course they are required to study the manufacture of the various parts of a product, the assembly and the quality aspects of producing these parts, taking into account design, marketing, materials, engineering and financial considerations. Through this process they learn the technical jargon, write a report on the product, and present the results of their work in the foreign language to representatives from sponsoring engineering companies and their peer group. At least one native speaker with technical knowledge joins the group for the whole duration of the project, gives help with missing words and corrects grammar and pronunciation.

A second, lecture-based course is also used to impart technical language knowledge: the 'Drawing and Design Class'. The students learn about graphical communication, drawing office standards and the manufacturability of a design. The language students receive part of their exercises formulated in French or German. Some of the tasks have to be completed in line with standards applicable in France or Germany.

Year 2 students on the 'with languages' programmes are offered the technical part of language acquisition in the form of mathematics lectures. The native French or German lecturer, a graduate engineer, gives the lesson in the foreign language. Although some of the explanations may need to be repeated in English, in general the students are able to learn both the new vocabulary and the mathematics taught in this manner.

'With German' students undertake their third year abroad, currently at the Swiss Federal Institute of Technology in Zurich. In future there will also be an opportunity for studying in Aachen, Germany. The courses taught in French for third-year students are operations research and manufacturing systems design. Operations Research is still fairly mathematical and builds on the knowledge acquired in year two whilst introducing new technical 'jargon'. The manufacturing systems design class moves away from numbers and formulae and is a management-biased lecture involving a group project. Some of the 'with French' students take their fourth year abroad, at Ecole Centrale de Lille, whilst the others will follow a weekly project management seminar in French where they will be able to discuss the progress of their fourth year project between each other with the help of a native tutor. The 'with German' students will follow a similar option in German.

Figures 1 and 2 show the repartition of disciplines between subject areas and the languages in which they are taught over the first three years of the courses (the repartition for the fourth year depends on each student's option choices but these must include a minimum 20% language content).

Communication and awareness training

Continuous contact with German- and French-educated engineers throughout the academic periods of the programme forms one element of the process of 'internationalizing' different approaches to engineering. A one-week project during the second academic period, where students work as a team in an industrial organization in France or Germany, forms a second element. During this project the students are supervised and work with European engineers as well as a Brunel engineering lecturer. At the end of the week's work the students write a report in the foreign language about the project. This prepares students for the industrial placements abroad. Part of the second and the whole of the third industrial period are normally spent abroad. These industrial work placements, supervised by Brunel tutors, form the third element

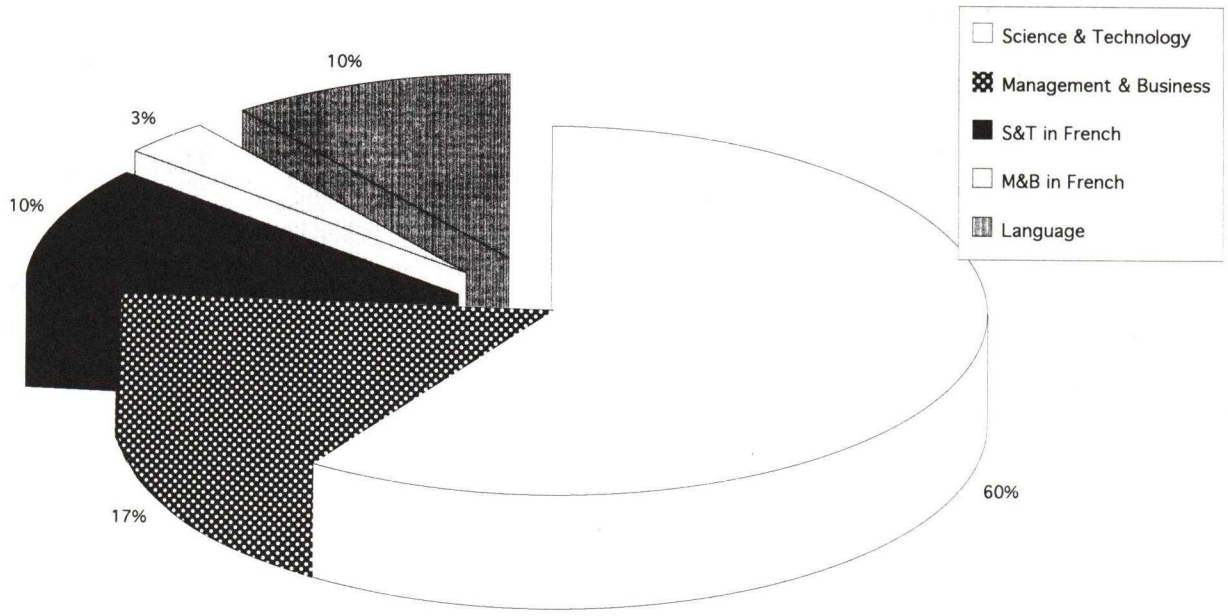

Fig. 1. Overall subject repartition for the first three years.

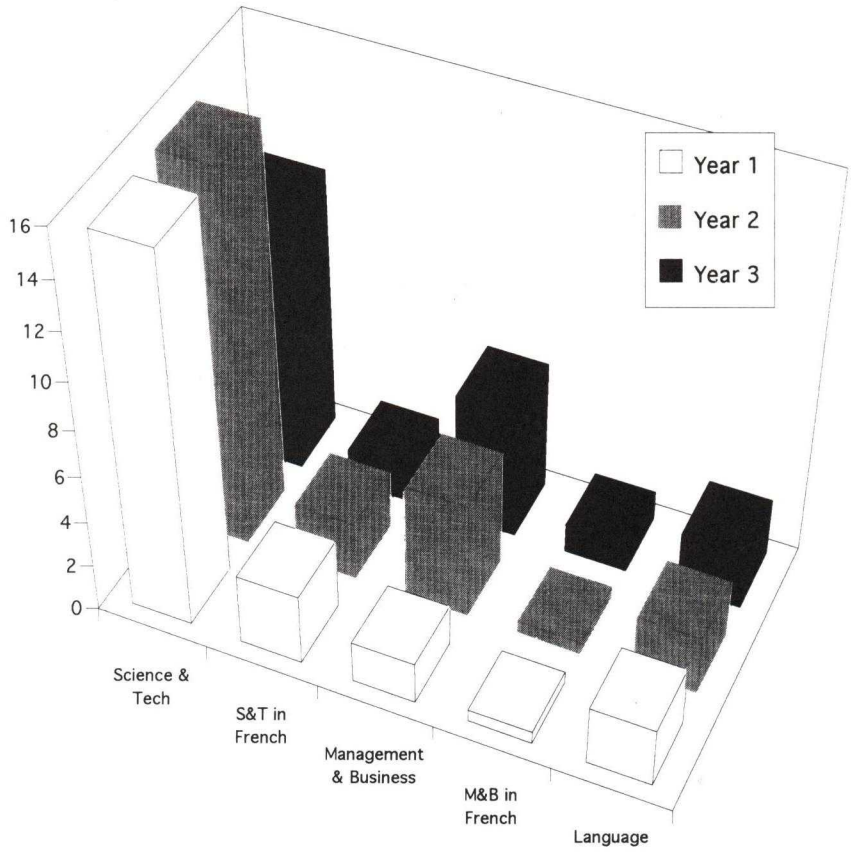

Fig. 2. Year-by-year subject repartition (hours per week).

of communications training. Finally, all students are expected to spend an academic period abroad (third year for 'with German' students and fourth year for 'with French' students).

To facilitate the placements of the students abroad, the languages team has developed links with a number of European institutions and companies. The exchanges are supported by the European Community's Erasmus and Comett programmes as well as by the Royal Academy of Engineering.

STUDENT ASSESSMENT—PERIODS ABROAD

Students are closely monitored as to their language ability, and are expected to demonstrate the high level of competence in the languages which is necessary to study, work and communicate professionally. The courses are designed such that this competence can be developed during the studies at Brunel University rather than relying on earlier learning.

Once working or studying abroad the student is expected to maintain close links with the personal tutor at the home institution, using the fastest means of information transmission available (e-mail, fax, telephone, etc.). The host institution is encouraged to nominate a personal tutor for the student. Experience up to now indicates that the students use all the electronic means appropriately and generally in the foreign language.

In the case where a student spends the academic part of his or her final year abroad, a Brunel-based supervisor for the final year project is also appointed. The personal tutor at Brunel and, if applicable, project supervisor will establish contact with the relevant authorities and staff at the host institution and will develop suitable channels for communicating the student's progress and the results of assessments carried out. The Department has developed guidelines for transferring marks between the different systems. Whilst every effort is made to ensure a fair and objective grading of a student who has studied at another institution it must be recognized that it is impossible to assure absolute accuracy in translating marks obtained elsewhere into 'accurate' percentage points. However, the range of information available, e.g., marks and conversion tables developed by Brunel staff, assessed work, personal reports, position within the class at the host institution and interviews, ensures correct placement within the bands corresponding to degree classes. Experience with the pilot group of students, one of whom has recently received the Diplôme d'Ingénieur de l'Ecole Centrale de Lille together with BEng and MEng degrees from Brunel University, would appear to show that assessment methods are satisfactory and encourage students to perform well.

A member of staff of the University visits the students during the periods of work and study abroad and discusses progress with the personal tutor or other staff at the host institution. This is aimed at ensuring that the needs of the individual student are met both at a technical and at a linguistic level. The student is encouraged to keep a log-book during his or her stay at the host institution and to use this to keep a record of meetings and communications from both Brunel University and the host institution. This helps the student in planning his or her work and in maintaining regular and productive links with the tutor and supervisor.

Interestingly, students on the 'with languages' programmes perform, on average, substantially better than students on the more mainstream engineering courses. The difference is usually equivalent to one degree classification.

EVALUATION

Both the students and the languages team are very enthusiastic about the courses developed and a great deal seems to have been achieved. The three-tiered approach to language training which had seemed important to a team who did not want to form linguists but engineers would appear to work well. Students and graduates are able to work effectively alongside their European colleagues, understanding their jargon, and are able to communicate accurately and with confidence both orally and in writing.

The companies in which the students have worked so far have praised their language abilities and competencies and the students studying abroad have performed very well. Their language abilities never seem to have been a problem unlike what was expected from examples of previous exchange programmes in other higher education establishments [4].

Similarly, the academic achievements of the students on a technical level have been comparable, if not a little higher, to those students not taking the 'with language' courses. This contradicts the conclusions established by Jochems [5] who argues that 'switching from the mother tongue to a foreign language has considerable negative effects' and results in the didactic quality of engineering education conducted in the foreign language being lower [5]. Jochems acknowledges that in some cases greater study efforts can compensate for slower learning.Indeed, in the case described by this paper, increased student and staff motivation, coupled with a 'feeling special' factor, have ensured that we have not had to compromise on the technical side while still being able to provide a substantial language input.

It must, however, be said that a potential drawback of our approach is the high demand it places on resources. Putting the 'with languages' courses in place has required much effort and commitment, as also experienced in similar developments elsewhere in Britain [6].

The number of applications for the 1993 entry is up by approximately 50% compared to the applications for 1992, which shows that this type of course is becoming increasingly popular. In our experience, there are many reasons for the increased popularity of the courses. Mulhall [7] points out that some students chose a 'with language' degree as part of a career plan or to keep their options open. We have also noticed whilst interviewing students that most applicants are keen to add the language dimension to their degree as something that will make them more attractive than traditional engineering students to prospective employers. Indeed, credible language skills can only be an advantage on today's job market as also mentioned by Meillier [8].

CONCLUSION

Engineering education as a process has changed dramatically over the past 20 years. Most providers of university-based courses have managed to adapt engineering studies to the needs of industry in line with the recommendations of the Finniston report [9] and other reviews of the role of the professional engineer. Courses now include elements covering most management disciplines from personnel management to investment appraisal. A key element is, as a matter of course, communication between peers and all other groups involved in the design and production of goods of any kind. A communications skills course is a major component of the first years of both BME and SEP. Students learn to make oral and written presentations, to argue their views in a group or team context and to take decisions based on a background of limited information.

The development of the 'with language' programmes can thus be viewed as a natural extension of the existing communications training. The need for the development of such engineering courses with integrated learning of a foreign language is perhaps more pronounced in Britain than elsewhere. Only a few professional engineers in the UK speak a foreign language while a majority does so in Germany, to a good standard. However, educators outside Britain may well decide to include the study of a foreign language to a high level of competence in some of their programmes to encourage a broader cross-section of students, qualified to enter university, to consider engineering as a career. The authors feel that the skills profile of engineers will continue to change to account for industry-driven moves towards multicultural and multinational teams dealing with complex problems in a highly competitive and uncertain environment. Communications and linguistic abilities will assume key significance.

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