

## **Developing an undergraduate course to meet employers' and students' needs**

Claire Davis and Elizabeth Wilcock

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### **Summary**

This document describes the development and implementation of a new course (BSc in Sports and Materials Science) at the University of Birmingham. Careful consideration of employers' and students' needs was made during the course development, particularly in terms of technical and key skills and the teaching strategies adopted for effective learning.

### **Biography**

Dr Claire Davis is a senior lecturer in the School of Engineering at the University of Birmingham. She was awarded a National Teaching Fellowship (NTF) in 2001. Elizabeth Wilcock was appointed as a research assistant on the NTF grant and has been researching the pedagogy of case study learning with Dr Davis.

### **Keywords**

Student needs, employability, teaching and learning, final-year projects, evaluation

### **Background**

The BSc in Sports and Materials Science at the University of Birmingham was introduced in 1997 and combines an appreciation of the advanced materials used in sporting equipment with the practical and theoretical knowledge of sports and exercise sciences.

The course was developed by the Department of Metallurgy and Materials in collaboration with the Department of Sports and Exercise Sciences and was created in recognition of the increasing importance of high-tech equipment in today's sporting industry. An additional aim was to attract more students to the study of materials science, a subject that is unfamiliar to most pre-university students. The course has now grown from an initial intake of 7 students in 1997 to 25 entering level 1 in 2003.

The Department has been active in sports materials research (e.g. sports safety equipment such as crash helmets and foam cushioning) for many years. The development of the course also stimulated new research activities, for example on golf clubs, tennis equipment, Formula 1 racing car components and prosthetic limbs for athletes. The research strength in the Department (5\* RAE rated) facilitated the development of the course through its established links to companies for course endorsement and topics for case studies and undergraduate projects.

### **Teaching strategies**

The course takes students with a range of background skills (in terms of learning styles, motivation and key skills) and varied academic qualifications (science and humanities A-levels or equivalent qualifications). In order to show the relevance of the physical science concepts associated with the Materials Science components of the course, and to cater

for the different student learning styles, a high proportion of case study teaching was introduced. This teaching method contrasts with the other courses run in the Department where more traditional lecture and laboratory teaching is used. The benefits of case study teaching are well documented; and the main reasons for incorporating them are as follows:

- To promote active learning (Grant, 1997; Kuntz and Hesslar, 1998; Richards et al, 1995)
- To expose students to real-world issues (Raju and Sanker, 1999)
- To incorporate a variety of learning activities (Wilcock and Davis, 2003)
- To provide an opportunity for the development of key skills such as group working, communication and problem solving
- To increase student motivation and enjoyment of a topic (Mustoe and Croft, 1999).

The case studies typically involve the students carrying out directed learning (research, data analysis and / or experimental characterisation) focused on a particular item of sports equipment. Evaluation has played a key role in the understanding and development of this learning approach. Student feedback in particular has helped to adjust and improve many aspects of the case studies such as content, format and assessment. For example:

- **Group working:** Many of the case studies are group-based, since potential employers identified working as part of a team as a valuable skill. However, feedback has shown that many students have little experience of group working on entering university and therefore often experience difficulties in terms of group dynamics and task allocation. The Department has included sessions on group working skills and provides tips and advice on a support website.
- **Clear explanation of requirements:** Evaluation has shown that students require clear instructions of what is expected of them during case study work, e.g. level of independent research, how to write reports, give presentations or present posters. This is particularly important at the beginning of the course as for many students this style of learning will be very different to the one they were used to at school.
- **Assessment:** For group activities appropriate assessment strategies are required to ensure individual contributions are also recorded. In addition, careful consideration should be given to how many marks are allocated to case studies. Within the Sports and Materials Science course, it was found that some students spent a considerable amount of time on their case study work, yet felt that they were not receiving enough credit for it.

Further details of the case study learning used in the Sports and Materials Science course can be found at [www.cases.bham.ac.uk](http://www.cases.bham.ac.uk). This website includes information on the structure and format of the case studies as well as generic issues such as key skills and assessment.

## Project design: final-year project

Final-year undergraduate research projects are a common element of many science and engineering degree courses and account for a significant part of the overall degree mark. The BSc Sports and Materials Science course projects typically involve experimental research into the materials and processing techniques used in an item of sports equipment, following the style of project used in our traditional BEng courses. Whilst students on the BEng degrees are generally interested in technical careers using their engineering skills, for instance as practising engineers or consultants, or using their generic skills (numeracy, project management, communications etc) for instance in accountancy etc, some students on the BSc degree are not interested or motivated by technical career opportunities but would like to become teachers or youth leaders. In order to meet these students' needs in 2002 a new style of final-year project was offered in addition to the technical research projects. The project required students to research teaching styles and develop case study teaching for pre-university level students in the area of sports materials.

Six final-year BSc students, interested in a career in teaching, selected the projects. The initial stage of the project involved them in examining school curriculum content for the selected age group (14-15-year olds) to determine areas relevant to Materials Science (e.g. from Science, Design and Technology, Physics and Chemistry syllabi). Students also reviewed educational literature concerning case study teaching (e.g. case study definitions, benefits of case study teaching, learning styles etc). The main part of the project required students to develop a case study on an area of science in sporting equipment of their choice, informed by their earlier research and to include carrying out detailed experimental investigations to develop the case study content.

As the project progressed, opportunities arose for students to 'test-run' their case studies with school students and to work with a company called 'Sports by Design' who specialise in running sports/science workshops in schools. The case studies have also been used in workshops for GCSE students run at the University over the summer. Feedback from the students involved in this project has been very positive. One student commented:

*'It was great that I could combine materials with education – it allowed for creativity and was very challenging.'*

## Employability

Before developing the course we felt it was important to determine whether the programme would meet the needs of potential future employers. Sports equipment manufacturers (production and research & development departments), local education authorities (for students with careers aspirations in teaching) and leisure facilities were contacted to determine their views on the course and the skills/knowledge the students would acquire. The response was very encouraging, with many companies expressing an interest in this area of study. The course has now seen four years of students graduating and typically students move into three areas: research/marketing/finance in companies, teaching, or further postgraduate studies. Of the six students who took part in the final-year project described above, three have moved into a teaching role.

## Conclusions

The experience of developing a Sports and Materials Science course has been very rewarding. The course has grown in student numbers and developed in terms of teaching strategies since initial implementation in 1997. Key to its success has been the consideration of and response to student needs made at various points during the course development and progress, for example in the introduction of significant amounts of case study teaching and in the topics selected for final-year projects. Evaluation of the course structure and teaching strategies continues to be made in order to reflect and develop the course further still.

## References

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## Website links

Examples of case studies in Sports and Materials Science course: <http://www.cases.bham.ac.uk>

Details of a series of booklets on teaching and learning in Materials Science (including 'Teaching Materials Using Case Studies'): <http://www.materials.ac.uk/groups/index.asp>

Project based learning in Engineering: <http://www.pble.ac.uk/>

One-stop resource centre for the development of project work in Electrical/Electronic Engineering degree courses: <http://www.eee.ntu.ac.uk/pp/>

The National Teaching Fellowship Scheme: <http://www.ntfs.ac.uk/>