

# Chapter 10

## The Knee Bone Connected To the Thigh Bone: A Case Study of Teaching Anatomy to Engineering Students Using State-of-the-Art Anatomical Software

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### ABSTRACT

*Bioengineering is a multidisciplinary subject which necessitates that engineering students, who typically have no knowledge of medicine, must quickly and effectively gain a thorough understanding of the complexities of human anatomy. Teaching on a Bioengineering module at Newcastle University's School of Mechanical and Systems Engineering employed a combination of Primal Pictures anatomical software, bespoke teaching materials and peer to peer learning. This allowed Bioengineering students to quickly construct an understanding of anatomical principles which they used in individual, assessed projects on total joint replacement. Anonymised, written feedback gathered from the students revealed overwhelmingly positive learning experiences and assessed projects indicated deep knowledge of the anatomical descriptions necessary to understand and work with the science of joint replacement.*

### ORGANIZATION BACKGROUND

Newcastle University is a member of the Russell Group, comprising 20 leading research institutions in the UK. The 2008 Research Assessment Exercise (RAE) found that in over two thirds of subjects assessed, at least half of all research was placed

in the top two categories of 4\* (world leading) and 3\* (internationally excellent). Based on these results, Newcastle University is among the top 20 higher education institutions in the UK in terms of research power, according to the publication, Research Fortnight.

The School of Mechanical and Systems Engineering at Newcastle University has a history dating back to 1871 and has strong links to local

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and international engineering industry. The 2008 RAE placed the School in the top 10 mechanical engineering departments in the UK for research. The University's mission statement is to be a world-class research-intensive university, to deliver teaching of the highest quality and to play a leading role in the economic, social and cultural development of the North East of England. The University has three faculties, one of which is Science, Agriculture and Engineering (SAGe). Mechanical and Systems Engineering (MSE) is one of ten Schools within SAGe. The School of Mechanical and Systems Engineering has 19 full-time lecturing staff and a student cohort of approximately 400 undergraduate and postgraduates undertaking a range of BEng, MEng and MSc degrees.

## **SETTING THE STAGE**

In the School of Mechanical and Systems Engineering the subject of Bioengineering is taught as a 15 credit module over two semesters to fourth year MEng undergraduate students as well as postgraduate MSc students. Two members of academic staff teach the course, taking 1/3 and 2/3 shares of the teaching load. On alternate years they swap the teaching load so that one year they teach 1/3 and the next 2/3. Course delivery and assessment previously followed a conventional pattern of lectures and tutorials with assessment based on a written examination at the end of the module. In the 2008-09 academic year the lead author became module leader. Based on his pedagogical views and experiences a number of changes were introduced to the Bioengineering module. For his 'third' of the module, assessment was swapped from final exam to an individual, 3000 word project based on a critique of a commercially available total joint replacement. As such a critique needs to be founded on a full appreciation of the anatomy of the human joint that is being replaced, so the challenge was how to facilitate student learning

of the complex subject of anatomy. In addition, for the majority of the bioengineering students, this would be the first time they had been formally introduced to anatomy and the associated medical terminology.

## **CASE DESCRIPTION**

### **Introduction**

Bioengineering - the application of engineering principles and techniques to the medical field - contributes towards the improvement of medical interventions in many ways. One of the discipline's most important contributions has been the design of artificial joints, a development which is recognised as the twentieth century's major advancement in orthopaedics. Millions of joint replacements have been implanted leading to improved quality of life for many thousands of people suffering from crippling musculo-skeletal diseases. These artificial joints are designed by engineers who need to be fully conversant with human anatomy and the associated medical language. The challenge then, is how to immerse undergraduate engineering students quickly and efficiently in an alien subject and give them sufficient knowledge for them to apply engineering principles to this exciting topic?

### **Pedagogical Background**

Functional anatomy is a strongly three-dimensional subject where spatial visualisation is key (Van Sint Jan et al., 2003). Commentators have noted that medical students frequently encounter problems in understanding certain dynamic aspects of functional anatomy (Van Sint Jan et al., 2003) and this is likely to be the case with engineering students too. It has also been shown that the application of multimedia has helped students to increase their 3D anatomical understanding by giving them spatial direction about the underly-

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