Chapter 18
Evolving Use of Educational Technologies: Enhancing Lectures

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ABSTRACT
This chapter describes the use of educational technology for enhancing student learning at the School of Electrical Engineering and Telecommunications (EE&T) at the University of New South Wales (UNSW). Over the past decade, the school has introduced and trialled various technology-based approaches in the form of electronic whiteboard-based lectures for remote teaching, voice-over power-point screencasts using tablet PCs for tutorial problems, pre-recorded dynamically annotated lecture material delivered initially via DVDs and later hosted on the cloud as support material for live lectures, distributed laboratories capable of real-time interaction via video, audio and digital annotations, and most recently, the use of iPads to aid in lecture delivery. The impact of these approaches is evaluated in this chapter using student surveys over multiple years, some of which are still on-going. The results of these surveys show that technology-based approaches have a positive impact on student learning experiences. In particular, the students found that the video capture of lectures with appropriate dynamic annotation as support material allowed for flexible learning to suit individual styles.

INTRODUCTION
Numerous challenges exist in higher education environments, particularly engineering education in a multicultural society. Some of these include the effective communication of difficult mathematical concepts, maintaining students’ attention span, the difficulties of catering for individual student needs in a large classroom environment, different paces of student learning, lack in fluency in spoken and/or written English, and students losing continuity due to missed classes. As a result, only a small
percentage of students are usually able to grasp the key concepts at the time of the live lecture delivery, while the remaining students are left to try and develop this critical understanding in their own time, with whatever assistance and resources they can find and comprehend.

The challenge of maintaining student attention span (Foreman, 2003), especially in large classes, is exacerbated by difficulties students face, such as fatigue or non-attendance due to balancing part-time work or other commitments, or difficulties with comprehension for students whose first language is not English. Even for a lecturer who is engaging, enthusiastic and charismatic, it is virtually impossible for them to hold the attention of a large group of students for more than 30-45 minutes. Previous studies (Brotherton & Abowd, 2004) have shown that students prefer to study in their own time, when they are less fatigued, rather than attending regular structured classes. We believe that the availability of resources for out of class study is particularly critical for science and engineering students, where long and complex mathematical concepts are often conveyed, and in which the live lecture environment provides little support for any student who loses the train of a particular derivation or explanation. For example, even with printed lecture notes and student note-taking, it is still easy for a student to miss a crucial step in the explanation of a difficult, but conceptually important, problem (E. Ambikairajah, Epps, Ming, & Celler, 2006).

Student attendance in lectures has also reached low levels in recent years, particularly in a large class environment. The criteria that a student uses to determine whether to attend a lecture or not includes: Are they going to learn anything that they cannot obtain later? How much interest does the lecturer create for the student in this lecture? If they do attend, are they realistically going to pay attention and learn in the class? Would they prefer to obtain the lecture material at a later time and study when they are more focused and enthusiastic?

Traditional methods of teaching involve writing on a blackboard or jotting down information on projection slides, and remain the principle methods that many lecturers still use today. As students copy down the information, they have a somewhat low absorption of the material that is actually being taught, due to the fact that their main concern is writing all the information down, rather than listening to, and understanding, what the lecturer is saying. Even when lecture notes are displayed in the form of PowerPoint slides with animation and colour, students slip in and out of concentration in the lectures. However, when lecture notes are provided to students before the lecture starts, either as printed notes or on the web, the absorption rate of material in the class is much higher, as students can pay more attention to the ideas conveyed by the lecturer, rather than blindly copying down notes (E. Ambikairajah et al., 2006).

In order to address the above problems, and in pursuit of optimal student learning, students’ individual learning styles need to be taken into account. Students must be able to obtain immediate clarification if they encounter problems in their learning instant. Lecture material, and the way in which it is presented to students in the class, should encourage students to learn and discover new knowledge.

Previous attempts to address the problems have included videotaping of lectures, but this proved to be somewhat unsuccessful, as large scale equipment set up was required. Multiple cameras were needed and students were not compelled to watch these videotaped lectures on their televisions at home. Another method included a voiceover to accompany PowerPoint slides (E. Ambikairajah, Epps, Ming, Celler, & Chen, 2005). This