Preface

Educational technology is transforming higher education by stealth. Word processors, PowerPoint presentations, learning management systems, and mobile devices are all chipping away at the traditional model of the lecturer on the stage. Wikipedia and other online resources allow students to quickly get the facts on a topic rather than wait for the lecturer to dictate them. Suddenly, inquiry-based learning is simple to do. Fifty years ago, it required special cooperation from the library.

Now, a student can inquire anytime, anywhere. Student-centred learning is possible as never before. Classrooms are flipping as students do their information gathering outside of the classroom (perhaps assisted by lecturer-prepared 5-10 minute videos). The classroom becomes the place for adding value to what has been read or watched already. Are there misconceptions that need to be addressed? What needs to be learned next in the inquiry process?

In this model of learning and teaching, what the student now needs to develop are the skills for finding, resourcing, and assessing information. The information itself is easy to find, and delivery of content alone is not enough. Learning and teaching thus becomes a guided enquiry where the student must be given opportunities to discover and develop their own understanding of the discipline area.

This book seeks to address some of the issues and concerns raised by educators when faced with this new, information-rich environment. The chapters provide a range of expert views, which deal with common issues and misconceptions as well as best practice solutions.

LAYOUT OF THE BOOK

The chapters have been formed into 3 sections, which are important within the changing environment of learning and teaching. The 3 sections are ones that we need to keep in mind as we redesign our educational processes:

Section 1: Curriculum Issues within the E-Learning Environment

Section 1 examines the interaction between the mode of the delivery and the design, structure, and implementation of the curriculum. Particular topics of importance here are:

- Problem-based learning in traditional and blended learning environments;
- Implementing a student-centred approach within a blended learning environment;
- Development of appropriate curriculum structure.
Section 1 includes:

Chapter 1: Implementing Educational Technologies: Capacity Building

This chapter explores some of the educational technology opportunities that are available and are likely to become available for providers of engineering education. Framing this exploration are three overarching considerations: imitative or creative uses of technology, off-the-shelf educational products versus custom built products, and support for and resistance to educational technologies.

Chapter 2: Teaching of Fluid Mechanics in Engineering Course: A Student-Centered Blended Learning Approach

In undergraduate engineering courses, fluid mechanics is regarded as a challenging subject. This is particularly the case for students who do not possess a strong mathematical background. This chapter reviews the issues related to the teaching of fluid mechanics with an emphasis on how e-technology can enhance student learning. It has been found that teaching based on a "student-centered approach" is more effective in teaching fluid mechanics than a "lecturer-centered approach." Further enhancements are proposed in UWS through a blended learning approach involving both e-technology and traditional teaching methods to teach fluid mechanics.

Chapter 3: Blending Conventional Methods with Emerging Flight Simulation Technology as Tools for Effective Teaching and Learning Experiences in Aerospace Engineering

Engineering is about wealth creation for the comfort and well-being of human beings. In this context, the process and experiences associated with teaching and learning of engineering concepts are pivotal in sustaining and advancing the progress of modern day civilization. At the University of New South Wales in Australia, the authors have been experimenting and refining what is generally known as the "advanced project design study concept" used in some aerospace industries and incorporated it as an integral component in aerospace engineering studies. In the process, the authors have blended conventional methods with flight simulation as methods of enquiry and investigation. This chapter outlines the basic philosophies behind the authors’ approach and the methodologies and technologies used in achieving the desired outcomes.

Chapter 4: Enhancement of Student Learning for Effective Capstone Project Outcomes

It is commonly accepted that today’s engineers are required to deal with a whole range of matters involving scientific, technological, and importantly communication issues, and so need to be educated with these aspect in mind. The pedagogy of engineering requires a better understanding of students’ abilities to guide their approach to learning the necessary skills of working in the engineering community. Consequently, there is an ever-increasing need for engineering graduates who are able to communicate effectively. In many engineering courses around the world, one of the key aspects required of the students is that they complete an independent project in their final year of studies. This chapter examines student abilities and skills required to successfully develop capstone projects which involve research skills, communication skills, and information-retrieval abilities.
Chapter 5: Module-Based Teaching of Mechanical Design

Teaching engineering in the context of practical problems has been suggested as a way to motivate and interest students. By module-based teaching, it is possible to make the contents easier for the students to imbibe and to highlight the interdisciplinary nature of mechanical design. The purposes of this chapter are to describe (1) five modules for introducing Mechanical Design courses in Mechanical Engineering, (2) the differences in emphases of the modules, (3) the most important aspects of the modules, (4) student reactions to the module-based teaching approach, and (5) student reactions in terms of the ease of learning.

Chapter 6: Using Real World Applications as Technological Tools in Engineering Education

This chapter is based on a number of engineering courses taught by the author in recent years. During the author’s delivery of lectures and tutorials, he took the opportunity to use real world applications and situations to arouse interest and enabled students to understand basic underlying principles before progressing to theoretical treatment and mathematical modeling. The methodology and pace allow the confidence of his students to improve which leads to better motivation. This also provides students with the ability to look deeper into concepts and creates a virtuous environment for both teaching and learning.

Chapter 7: Undergraduate and Postgraduate Education in Renewable Energy

The UNSW solar cell research group has led international commercialisations and, since 2000, pioneered specialised undergraduate education in photovoltaics engineering. The Photovoltaics and Solar Energy undergraduate program is a unique four-year full-time Bachelor of Engineering program covering device theory; photovoltaic technology and manufacturing; photovoltaic applications and system design; policy, analysis, and modelling; renewable energy technologies; and sustainable energy. In-house developed technical tools are used extensively in teaching and research.

Chapter 8: Control Systems: The Overarching Discipline

The field of engineering is undergoing rapid advances in knowledge application. Present drivers for the advances in engineering are clearly electronics, materials engineering and information technology. As innovation applications abound, employers expect educators to produce students having the latest knowledge of advances in their native discipline. This aim needs to be achieved in the same four-year time-frame and yet the degree needs to contain increasing research-orientated content to comply with Australian Quality Framework requirements. How these ends can be achieved within the context of a high-quality engineering degree becomes a challenging task. The author suggests that a solution can arise by utilising a Systems approach from the very first year of an engineering degree across several electro-mechanical disciplines.
Chapter 9: Automotive Engineering Education at the National University of Singapore

This chapter addresses the coursework that graduating engineers could benefit from before entering a career in the automotive industry. It describes the curriculum offered by the Department of Mechanical Engineering at the National University of Singapore to students electing an automotive specialization.

Chapter 10: Online Postgraduate Program Development

Due to changes in business requirements, a defence consortium has the desire to develop the Master of Systems Support Engineering program for professional development of their future leaders. The challenge in this industry sponsored program development is the need to fully integrate expert knowledge in the field to the fundamental theories in the subject matter and to deliver this body of knowledge to working professionals online.

Section 2: Discipline-Specific Electronic and Online Tools for Learning

Section 2 focuses on several case studies that examine the efficacy of discipline-specific online or electronic tools, which are now readily available to both students and instructors. Of interest here are:

- The use of mobile devices in the provision of feedback to students and in improving the overall productivity of the instructor;
- The use of discipline specific technological tools to enhance student learning;
- The use of electronic portal system as a virtual campus.

Section 2 includes:

Chapter 11: Innovative Teaching Practice and Assessment with Technology Applications in International Biomedical Engineering Education

The advantages of the Internet in education are widely acknowledged by students and teachers all over the world. The authors have developed EVICAB as a free-access portal for e-learning with a full curriculum in biomedical engineering. It also offers a system for an Internet examination, which makes it possible for the students to take the examination anywhere in the world, where an educational institution provides proper environment. In this chapter, the authors briefly introduce the technology of the EVICAB portal and discuss in more detail the application of the Internet examination system.

Chapter 12: The Tablet PC: A Complete Teaching Studio

The Tablet PC is a flexible teaching tool. It can be used to increase the lecturer’s productivity in note taking and in assignment marking. It can be used in the lecture room with increased interaction. Containing the abilities of both a tablet device with multi touch, a pen interface for accurate drawing and handwriting and with the power of a full PC, it is a complete teaching studio.
Chapter 13: Strategies to Remove Barriers and Increase Motivation to Use the Tablet PC in Formative Assessment

The Tablet PC has been employed to provide feedback through formative assessment to students in preparatory mathematics courses at Central Queensland University for close to a decade. A study conducted in 2011 on formative assessment and feedback given via the Tablet PC within these courses conveyed extremely positive outcomes. Building on the research and experiences of staff involved in the use of the Tablet PC to provide feedback on formative assessment in preparatory mathematics courses, strategies to implement and improve these practices in undergraduate engineering courses are investigated.

Chapter 14: Use of the Finite Element Method and Computational Fluid Dynamics in Motion Analysis of Complex Shapes, With Examples from Sports

In the research and development of sports, finite element methods (FEMs) and computer fluid dynamics (CFD) are frequently used as tools to examine the transformation of a solid and the flow of a fluid, respectively. To facilitate an understanding of the application of the FEM to sports research, an analysis of the impact of landing on the human body is presented. Similarly, the application of CFD to sports research is illustrated through a flow analysis around spiked shoes.

Chapter 15: The BIM Concept: The Role of the Engineering School

Building Information Modeling (BIM) is changing the way projects are constructed. This emerging practice requires new mind-sets and technological know-how in order to achieve significant improvements in building efficiency. Universities must focus on the strategy of using BIM as an innovative technology to allow the acquisition of new skills by students and prepare them for their future activity in a more competitive world. Based on this perspective, this chapter presents some educational measures on offer at the Technical University of Lisbon. It focuses on the importance of teaching BIM: the involvement of students in research projects, PhD theses, and MSc dissertations, and the dissemination of BIM through professional short courses and workshops addressed to the AEC community outside the school.

Section 3: Using Technology Tools to Enhance Student Learning and Student Engagement

Section 3 examines the use of generic online and electronic tools and how these can be implemented to enhance both student learning and student engagement. This section focuses on:

- Alternative modes of delivery, including the use of remote and simulated laboratories;
- The use of online collaborative learning tools;
- The forms and styles of online assessment and how to determine student readiness in undertaking online assessments.

Section 3 includes:
Chapter 16: eLearning: Challenges and Opportunities

eLearning will revolutionise higher education in the next decade. Although this has likely been said regularly over the last 20 years, the widespread availability of mobile devices, ubiquitous wifi connections and the globalisation of industry, driven by global networking infrastructure, will finally deliver the promises of learning anytime anywhere. This chapter reviews the most common forms of eLearning, both synchronous and asynchronous: recorded lectures, learning management systems, online assessment, blogs and wikis are slowly transforming education towards a student-centred model of learning.

Chapter 17: Understanding Students’ Use of Online Learning Tools through Online Learning Readiness Assessment

Understanding the readiness of students to undertake online education has been viewed as a necessary precursor to ensuring their success in an online learning environment. To serve this purpose, a number of Online Learning Readiness (OLR) assessment tools have been developed. However, the relationship between the students’ readiness, assessed by these tools, and the actual online learning outcomes has not been well established. This chapter presents a study that was aimed to assess the Online Learning Readiness (OLR) of a sample group of postgraduate engineering students and to determine whether there is any association between the level of readiness and the extent to which the students use online learning tools.

Chapter 18: Evolving Use of Educational Technologies: Enhancing Lectures

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 has been evaluated using student surveys over multiple years, some of which are still on-going.

Chapter 19: Assessment Practices using Online Tools in Undergraduate Programs

This chapter provides an overview of the use of online and Web-based learning technologies as formative and summative assessment. Peer learning and assessment, provision of feedback to students, online tests and quizzes, plagiarism detection systems, and audience response systems are all examined with a view to highlighting best practice and demonstrating that online assessment must still follow sound pedagogy to be both valid and valued by instructors and students alike.
Chapter 20: The Importance of Collaboratory: Using Collaboration Software to Engage and Assess Students in Computer-Screen-Based Tutorials

Researchers have identified active collaborative learning and membership in learning communities as factors that facilitate the engagement of learners. In the reported student engagement study a commercially available software utility was used to establish such an environment in a computer laboratory. This chapter addresses the following issues: will collaborative learning result in more student engagement and what type of software will support such activity?

Chapter 21: Technology-Enhanced Laboratory Experiments in Learning and Teaching

Laboratory practice plays a crucial role in engineering and technology education. The advancement of computational and computer technologies have ushered in a new horizon in learning and teaching of laboratory practices worldwide. Apart from traditional hands-on laboratory practice, two other laboratories namely the virtual/simulated laboratory and the remote control laboratory practices are playing an increasingly dominant role. The virtual and remote laboratory practices offer unique opportunities for students to visualise complex concepts and remove the time and location barrier. This chapter provides a comparative analysis of all three laboratory practices. Additionally, a 3-step laboratory practice and a hybrid laboratory practice developed at RMIT University are described.

The book chapters were selected on the basis of peer-review and upon decision of the editors. As may be imagined, learning and teaching for now and in the future is a complex area and the goal of this publication is to provide evidence of good practice and to identify new ways of teaching. In particular, it is becoming increasingly evident that textbook information is now readily available through many free online sources. Higher education needs to embrace this change and provide a space where academics can spend time designing and facilitating learning environments rather than just being “the sage on the stage.” The results for both students and staff are potentially enormous, with students acquiring skills relevant to a rapidly changing workforce and academics finding improvements in their own personal productivity and personal enjoyment in teaching.

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