INNOVATIONS 2008

World Innovations in Engineering Education and Research

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PREFACE

This volume is the 8th in the iNEER Innovations Series. The principal objective of the series is to promote information sharing to enable further progress through international collaboration. The articles in this book continue to develop many of the diverse subjects and concerns of topics selected for study in the recent books in the series and, in many cases, show the convergence of the solution approaches adopted. The chapters focus on teaching and learning and topics include the use of assessment methodologies in reforming engineering education, the integration of research with education, and the concern for producing engineers who will remain productive and relevant a dozen years from now. The multi-faceted topics addressed and solutions being adopted are briefly summarized below in the sequence in which the chapters appear.

GLOBALIZATION IMPACT ON ENGINEERING EDUCATION

This book gives a review of the ongoing globalization processes in the social, economic and technology fields. Calling them "civilization transformation phenomena" the author, Wojciech Zielinski, Rector of the Silesian University of Technology in Poland, indicates that these processes and phenomena have to be considered in strategy development for educational institutions (Chapter 1).

Implementation of the three-cycle reform in the Bologna signatory countries and issues relating to employability is reviewed by Kassinopoulos (2) whereas Scharle (3) starts with a short look at the Bologna process and a framework of concepts taken from cognitive psychology, then examines the role and quality of case studies applied in engineering education.

An international collaborative project aimed at developing a U.S.-European degree in Real-Time Software Engineering is discussed (4). A novel U.S.-China internship program initiated at the University of Missouri – Columbia (5) that features deep immersion in language and culture is offered as a response to the increasing importance of China not only as an economic power, but also an important partner in engineering education.

Two chapters in this volume deal with the teaching of English to engineering students at Brno University of Technology in the Czech Republic. The first concerns the process of constructing a flexible standard for English language based on the European criteria and requirements (6). The second deals with the meaning of English in the pragmatic sense and the way of its decoding, and focuses on pragmatic categories of discourse used in engineering, i.e. English for science and technology (7).

INNOVATIONS IN TEACHING AND LEARNING METHODOLOGIES

An account from Australia provides insight into the active learning experience of an academic in attempting to break down the separation between tutorials and lectures that remains typical of the university education in many places (8).

In the U.S., Brown (9) was concerned with the identification of the most common conceptual difficulties that students had in the sophomore (2nd Year) course on mechanics of materials, while Leonard (10) created student teams to design and build a trebuchet in which each team was required to design, develop and produce a working trebuchet using a problem-solving heuristic.

In Portugal, Sampaio and Costa (11) introduced into a computer aided drawing course the use of drawings based on parametric shapes, as a fast way to create similar design drawings.

Two of the chapters in this volume concern problem solving and student learning (12, 13). Additional studies deal with the development of professional skills among students (14); an introductory software programming course designed to appeal to undergraduate students (15); a project-oriented Engineering Clinic sequence (16); a project-based approach to teach the final year of a degree programme at the French Military Academy, St Cyr in Botswana (17); and a focus on adult learning in response to a major increase in the number of adults returning to third level education in Ireland (18).

CURRICULAR INNOVATIONS

To ensure that future engineers are armed with the necessary skills and knowledge for sustainable design of environmentally conscious products, a multi-faceted approach to incorporating eco-design and other green engineering principles into the curriculum is given by Zhou and Schoenung (19) and Dubikovsky et al. (20) describe an extra credit project in an advanced manufacturing processes course for aviation technologist.

In South Africa, Gibbon (21) implemented practical, hands-on laboratories in an electrical engineering curriculum. The work of Petrovic and Munukutla (22) concerns alternative energy technology. Duan (23) reviews and analyzes pre-engineering programs at high school and college level

A recent development to integrate nanotechnology into education is discussed by Mariotti et al. (24), while Dampier (25) discusses the elements of a professional law enforcement training program in digital forensics. At New Mexico State University, a new curriculum in the emerging process domain of micro assembly has been created (26).

In Colombia, authors describe the redesign of the industrial engineering curriculum (27) and an analysis of 'ExpoAndes', an activity for students that deals with teamwork, has been completed (28). Lin and Yu (29) advance a proposal for a collaborative approach to integrate engineering education with new product development at small enterprise in Taiwan. Other innovations include a sequence of 1-credit hour design courses at Western Michigan University (30), and measures implemented to counter the trend in declining enrollments in an Australia university (31); and an integrated "multilevel" training program in social and soft skills implemented in Austria (32).

E-LEARNING AND INTERNET TECHNOLOGIES

Badillo and Bourgeois (33) have examined various uses of information and communication technologies (ICT) by students based on observation of cases in France. They show that students do not strongly prefer ICT learning modes over more traditional approaches, and that uses of technology for educational purposes are diversified. "Blended learning" is clearly emerging, but the role of the teacher remains fundamental.

Virtual laboratories have been developed in Greece by Safigianni and Pournaras (34). In the U.S., distributed collaboration and virtual engineering concepts have been adopted in inter-university student projects (35); a web-based module has been applied to develop "virtual assembly" in a basic engineering thermodynamics course (36). In Russia, the work of Fedorov et al. (37) is aimed at raising the level of practical training on both equipment and software.

QUALITY ASSURANCE, EDUCATION INTEGRATION AND INFRASTRUCTURE

Recently, Buzwell (38) conducted a survey of Australian academic institutions on their practice of awarding the honours degree. The results show substantial diversity.

Two other papers from Australia deal with plagiarism. The first examines the issue as a "silent rot" that undercuts students' competencies and the pledge by institutions to produce quality graduates (39) while the second (40) discusses the authors' encounter with appalling student competencies caused by student plagiarism and the remedy that they implemented.

In Mexico, Lobato et al. (41) seek to identify the basic decision premises that influence the forms of organization and the well-being of employees, and conclude that higher education policies should not be based on the disciplinary tradition alone. Sandnes (42) summarizes the findings in a usability evaluation of *Fronter*, the learning management system employed to manage the curriculum in the human computer interaction (HCI) course at Oslo University College.

The chapter by Ferguson (43) concerns the development and implementation of a specialist undergraduate degree programme in acoustics in a research-led department and university. At the Stevens Institute of Technology in the U.S.A., McGrath et al. (44) developed an initiative as a collaborative effort between the School of Engineering and the institution's K-12 outreach center to promote a culture of inquiry in engineering education and engaging faculty in exploring research-based instructional strategies. Chen and Liu (45) developed and used a library of MathCAD modules for teaching graduate students both supercritical fluid extraction and modern theories of mixing rules.

Evans et al. (46) describe a mapping tool that grew from the entrepreneurship program at the University of Texas and from engineering design methods typically incorporated into undergraduate mechanical engineering programs. The tool uses function mapping to examine both the technology and the market phases and supports the education and practice of technology commercialization stemming from university, industry or government laboratories. The authors provide two examples of technology innovation using the tool.

Tiernan et al. (47) describe a bi-national effort to expose final year engineering student groups to research carried out by academics, while Flowers and his colleagues

(48) have designed a computational template to obtain the vibrational activity of molecules, emulating "locked" procedures of existing commercial molecular modeling programs. The simplicity of manipulations is consistent with the introduction of this subject, usually restricted to research papers, into the undergraduate curriculum.

At the Universidad del Norte professors implemented an assessment project on learning and teaching. Camacho (49) et al. discuss the various stages of the assessment. Kaminiski and Ferreira (50) used Quality Function Deployment (QFD) techniques to improve progressively the quality of continuing education programs in engineering. Cugnasca (51) presents the approaches for implementing and managing quality in the Cooperative Computer Engineering Course at the Polytechnic School of the University of São Paulo.

The chapter by Steichen et al. (52) rounds out the articles that comprise the present volume. They responded to the recurring needs for today's engineer to be well grounded in engineering design, problem solving, decision making, and be able to function cooperatively as a member of a multidisciplinary team. They used a facilitated evaluation approach to assess student outcomes and noted the overlap between intrinsic motivation and leadership as integral parts of the preparation of engineers.

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June 1, 2008

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WIN AUNG
Win Aung completed his baccalaureate studies in Burma (now Myanmar) and post-graduate studies University of Minnesota. He was a Member of Technical Staff at Bell Laboratories, Whippany, NJ, USA during 1969-1974. Since then, he has been at the U.S. National Science Foundation (NSF). He was appointed to the U.S. Senior Executive Service in 1985. He received the first NSF Federal Engineer of the Year Award in 1985. During 1976-1996, he held adjunct and visiting professorships at several universities in the U.S. and abroad. In 1994, he founded the International Conference on Engineering Education (ICEE) series and, in 2004, established the International Conference on Engineering Education and Research (iCEER) series. He co-founded the International Network for Engineering Education and Research (iNEER) in 2000, and is serving as its Secretary-General. He is the principal editor of the iNEER Innovations Series. He has published over 120 technical papers, and has edited or co-edited more than 10 books. He has been a Fellow of American Society of Mechanical Engineers (ASME) since 1983. He received the *Doctorem Honoris Causa* (honorary doctorate) from VSB – Technical University of Ostrava, Czech Republic, in 2005, and from the University of Pécs, Hungary in 2008. In 2005 he was awarded the Medal of Merit by Silesian University of Technology in Poland. He was a member of the Standing Committee on Theory and Fundamental Research of the ASME Heat Transfer Division, the ASME Board on Engineering Education, and the ASME Council on Education. He is a member of the Scientific Board of VSB - Technical University of Ostrava and was an editor of Transactions of ASME, Journal of Heat Transfer.

JOSEF MECSI received his BSc-MSc in Civil Engineering from the Technical University of Budapest in 1969, his CSc from the Hungarian Academy of Sciences in 1994, his PhD and Dr. habil. from the University of Miskolc, the former in 1996 and the latter in 1998. Professor Mecsi worked as a fellow researcher at the Technical University of Budapest from 1970 to 1985, a technical advisor at Vízügyi Építő Vállalat from 1985 to 1992, a private professor at the University of Miskolc from 1991 to 2005 and has served as a full professor and Dean of the University of Pécs, Pollack Mihály Faculty of Engineering since 2005. He has been a member of the Hungarian Accreditation Committee (MAB) Board since 2000, a core member of the committees ISSMGE-TC-28 and TC-40 since 2002, a representative of Hungary at the European Committee of Civil Engineering (ECCE) since 2002 and president of the Section of Geotechnics of the Hungarian Chamber of Engineers since 1996. He has authored more than 125 scientific publications and made more than 600 geotechnical reports.

JERZY MOSCINSKI
Jerzy Moscinski received the M.Sc. and Ph.D. degrees in Automation and Robotics from Silesian University of Technology, Gliwice, Poland, in 1982 and 1990 respectively. He has taught several courses in the field of Control, Signal Processing, Identification and Estimation, Computer Controlled Systems and Computer Networks in the Faculty of Automatic Control, Electronics and Computer Science, SUT, Gliwice, Poland. Since 1993 he has been involved in the organization of international co-operation at the Silesian University of Technology as Rector's Representative for International Collaboration. Dr. Moscinski has coordinated at the University level the international exchange of students and teachers, international vocational training programs as well as international collaboration in the field of research and development as head of the Regional Contact Point in Gliwice. He is an iNEER member and is involved in the organization of ICEE conferences. His main areas of interest include advanced control and signal processing, computer networks and their role in computer controlled systems and computer based education, Internet and multimedia technologies, international collaboration in education and research.

IAN ROUSE
A Professor and the Executive Dean of the Faculty of Health, Engineering and Sciences at Victoria University since 2005, Ian Rouse formerly served as a Professor of Health Sciences at Curtin University of Technology where he held the positions of Dean of Research and Enterprise and Acting Head of the School of Public Health. He graduated with first class honours in Biochemistry from the University of Western Australia in 1975 and completed a Doctorate in Epidemiology in the Department of Medicine of the University of Western Australia in 1986. He also completed with distinction a Graduate Diploma in Health Sciences from the Western Australian Institute of Technology in 1983. He worked in the fields of medical research, public health, epidemiology and health informatics in Western Australia, South Australia and at Harvard University. He held several prestigious fellowships including the Wyn Spence Medical Research Fellowship in 1983 and the CSIRO Division of Human Nutrition Research Fellowship at in Adelaide from 1986-1987. He was the General Manager of the Health Information Centre during 1995 – 1997, Chief Information Officer in the Department of Human Services in South Australia during 1997 – 1998, and Acting Chief Information Officer at Curtin University of Technology, 2000 - 2003. He has authored or co-authored more than 100 refereed papers, review articles and book chapters and have been associated with approximately 40 presentations at scientific meetings.

PETER WILLMOT
Peter Willmot is Principal University Teacher and Director of Undergraduate Studies in the School of Mechanical and Manufacturing Engineering at Loughborough University, England. He graduated with a BSc in Mechanical Engineering in 1976 and a PhD in 1990. During the intervening period, he worked in the high voltage switchgear, automotive component and petrochemical valve industries holding various design, production engineering and project management roles. He is a Chartered Engineer and a Member of the Institution of Engineering Designers. Peter was appointed Lecturer in Engineering Design at Loughborough University in 1985 and subsequently promoted to the senior staff in 2001 within the Teaching and Scholarship job family. He now has

responsibility for teaching, developing the curriculum and the professional accreditation of five undergraduate programmes. He sits on various university committees and has worked as external validator for the degree programmes of other universities. Winner of a university teaching prize in 2004 and an academic practice award for excellence and innovation in supporting learning in 2006 he has published widely on educational practice at national and international forums. Peter is also actively engaged on a number of substantial funded Teaching and Development projects including the Centre of Excellence in Teaching and Learning.

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