PREFACE

The year 2012 marks the 3^{rd} year following the ICEE / iCEER 2009 conference held in Seoul, South Korea. The great global economic and financial crisis reached its abyss earlier in March 2009 and was rebounding as members of the iNEER community met on August 23, 2009. On that day, however, the New York stock market index stood at around 9,500, still down drastically from its all-time closing high of over 14,000 reached on October 9, 2007. On August 23, 2009, the Korean currency, the Won, was trading close to a 10-year low at about 1,200 KRW to 1 USD. On that day, while the world market was in a daze, the iNEER community struck a surprisingly forward-looking and optimistic note as it opened its annual conference, ICEE / iCEER-2009.

In his keynote address, the Hon'ble Bertel Haarder, then Minister of Education of Denmark, noted the scope of the challenges presented by the global economic and financial crisis, but said that he was encouraged to see that researchers, teachers and students remained undaunted and undismayed, and were "dealing with the issues enthusiastically in bringing forward ideas, projects and sometimes astounding new combinations of already existing technologies."

In his opening remarks on that same day, Professor Tomas Cermak, Chair of the iNEER Board and Rector of the VSB – Technical University of Ostrava, Czech Republic, gave his opening remarks. Quoting the Prague Declaration, he called on political leaders to combat the global economic and financial crisis through investment in higher education and research.

Professor Doh-Yeon Kim, President of the University of Ulsan in Ulsan, South Korea reiterated these themes in another keynote address. He reminded the delegates to think beyond the current crisis, because today's students would likely be working up to 50 years later; therefore, to prepare students for their career, Kim said engineering education should be an interdisciplinary pursuit, and students should also study the humanities, social sciences and management, and be educated as "global people." In keeping with the air of general theme of optimism, he closed by playing "It's a Wonderful World" from the music CD by Louis Armstrong.

Events that evolved since 2009 have vindicated the general optimism emanating from ICEE / iCEER 2009. Today, the Dow Jones stood at 12,369.38, up more than 30% from the level on August 21, 2009. Investment in education and research has gone up in most if not all major economies. (The budget of the U.S. National Science Foundation, for example, has gone from $6.6 billion in 2009 to $7.04 billion in 2012.) With increased funding, the global community has continued to extend its work. Emerging topics such as the adoption of the iPAD in teaching and learning and of cloud computing are being seriously investigated in education, if not fully embraced.

Going forward, the magnitude of the continuing challenges faced by iNEER and its community should not be minimized, but since 2009, the community has met in three very successful conferences: in Poland (ICEE-2010), Northern Ireland (ICEE-2011), and Russia (ICIT-2012).

The last conference mentioned was a new series added by iNEER to its line-up of conferences. The International Conference on Information Technologies – 2012 (ICIT-2012) was successfully organized in the early part of June 2012 by the Saratov State Technical University in Saratov, Russia under the leadership of Rector Igor Pleve. It was attended by 387 participants from 21 countries, offering a rare and truly unique forum for the iNEER community to exchange ideas and share experiences with Russian faculty and students in the IT and related fields and, indeed, to engineering education in general. As one of the top-ranked state technical universities in Russia, SSTU is also a leader in the academic globalization efforts being pursued by Russian universities. In 2004, SSTU opened Russian engineering education to the international community for the first time when it hosted a meeting between an iNEER delegation of leading engineering educators and a group of rectors of Russian state technical universities. This led to the signing of the Saratov Communiqué, which in turn led to ICIT-2012.

In July, ICEE-2012 will convene in Turku, Finland. Over 600 members of the community submitted abstracts as authors and co-authors from close to 50 countries. The organizing team in Finland is striving for a world-class technical program, and a social program that is unmatched and uniquely Finland.

Meanwhile, the iNEER Innovation Series, published annually by iNEER, continued its appearances in 2010 and 2011, and these will be followed in July 2012 with *Innovations 2012* with robust contents. The appearance of *Innovations 2012*, representing the 12th edition of the Series, is timed with the opening of ICEE-2012. Topics discussed include advances in research-based education, assessment, engineering design, collaborative education, innovative teaching methods, collaborative education and problem-based learning, and others. Authors address their topics with drive and rigor, bringing forth ideas and solutions that cut across many disciplines. A sense of what they are doing is given below.

INTEGRATION OF RESEARCH WITH EDUCATION

Innovations 2012 opens with a chapter from Austria, in which Moeller et al. [Chapter 1] present the results of a survey of current simulation methodologies as they relate to skills required by engineers and scientists, as modern technologies approach the nanoscale. Simulation problems are described and summer courses for students dealing with micromagnetic simulations are presented.

In the U.S., research and education at the Center for Ecohydraulics Research, Mountain StreamLab (MSL), University of Idaho, involves a unique, complex, and expensive multi-user facility open to faculty and students from domestic and foreign universities [Budwig and Goodwin, Chapter 2]. MSL features a large-scale sediment flume that allows fundamental and applied research of processes related to mountain streams.

In a collaborative effort involving two universities, one in Qatar and the other in UK, Abdul Wahed and Nagy [3] are applying the control systems modelling approach to pedagogical research, focusing on the open- and closed-loop lecturing methods. Mathematical models are employed using control engineering techniques and tools to show that the learning and information retention dynamics differ considerably between the two modes.

ASSESSMENT AND EVALUATION

The College of Engineering at Virginia Tech in the U.S. is developing the pedagogy and related international experience, which is important for work in the global engineering context in which it is essential that students have skills in ethical leadership, team work, and communication [4].

A statistical analysis conducted by Anderson et al. [5] on the entire Texas Tech University Fall 2008 entrance class of 4,436 students indicates that the most significant discriminator on students electing to study engineering is gender followed by mathematics scores secured during entrance examination. At the Universidade Federal do Rio Grande do Sul in Brazil, the issue of low undergraduate enrolment and high drop-out rates is considered by Barone and Mizusaki [6]. They are partnering with local public schools to employ education robotics to give public school students an earlier experience with programming concepts, mechanics and projects design.

Komerath et al. at Georgia Tech [7] have studied how students utilize traditional learning approaches in courses delivering single discipline and interdisciplinary engineering content. They conclude that learning across disciplines demands initiative and independent exploration by the learner, and that communication between the student and faculty on expectations is key to success.

In Estonia, Umbleja et al. [8] are using a competence-based approach in measuring elementary skills and show it differs from the topic-based approach. They divide all exercises into small units checking only a small part of knowledge at a time. They use an algorithm which simulates the process of a student finding an answer, and guides the student towards certain tasks he/she needs to retake in order to fix gaps in the knowledge.

The adoption of cloud computing technology in higher education has been assessed at the Ta-Hwa Institute of Technology in Taiwan through a structured interview of administrators and faculty conducted by Liu [9]. To counter the problem of accidental and deliberate plagiarism, Cox [10] is embarking on a phased approach to educate students on correct citation and referencing practices.

DESIGN EDUCATION

In South Korea at the School of Electronics Engineering of Kyungpook National University, a freshman introductory course on creative engineering design has been developed by Kim and Song [11]. The course focuses on creativity, teamwork, design ability, and communication skills.

Moeller et al. [12] at the University of Hamburg in Austria are introducing undergraduate students to embedded intelligent systems using advanced NAO robots as a design framework. Students are highly motivated because of working with NAO robots.

COLLABORATIVE EDUCATION AND LINKAGES

As collaboration becomes more common in academia, the use of collaboration tools is an important issue. At the VSB - Technical University of Ostrava, Landryova and her co-workers describe their experience in adopting Sharepoint, a popular commercially available collaboration solution [13]. At the University of North Florida (UNF), Cox et al. [14] have adapted the RLab Remote Laboratory into the engineering curriculum. The facility permits remote experimentation in precision and advanced control engineering, and is being extended through continuing collaboration between UNF and Cologne University of Applied Sciences. At Texas Tech University a new, remotely accessible Microelectromechanical Systems (MEMS) laboratory has been developed and tested by Ramachandran et al. [15]. It incorporates a video feed from a digital microscope embedded into a live streaming server that allows students to quantify the motion of the dynamic MEMS devices.

In Japan, Takemata et al. [16] are engaged in a collaborative effort between a medical school and an institute of technology in which Problem-Based-Learning is employed at both institutions. The cross-fertilization that takes place have benefited and stimulated students at both institutions. At the Universitat Politècnica de Catalunya in Spain, Segalàs et al. [17] have implemented a European Project Semester (EPS) program that employs Project Based Learning. In Denmark, Freisel and Acevedo [18] are applying Project Based Learning in the teaching of mathematics in medialogy at two educational institutions.

Recently, to facilitate improved collaboration, the information and communication technology departments of three higher education institutions in Turku, Finland, have moved their activities to a single building, creating a joint campus [19]. This new facility provides a regional networking platform that facilitates project-based engineering and entrepreneurship.

INNOVATIONS IN TEACHING AND LEARNING

Even though many universities have included environmental courses in the curricula in order to promote sustainability awareness among students, at the Universidad Iberoamericana in Mexico Ruiz and Acevedo [20] are employing a novel approach. They use their university's solid waste management program to develop hands-on, environment-related learning experiences for engineering students. Students analyze and come up with solutions to a problem from different fields of knowledge, thereby contributing to the solution of a single common sustainability problem using different perspectives.

Abidin et al. [21] describe the results of a collaborative effort to identify and compare the learning styles of engineering undergraduates in Malaysia, South Africa and Finland. Five hundred and twenty-eight (528) engineering and technology undergraduates participated. The most favored is the social learning style, while the least favored is the verbal learning style. In Denmark, Reng [22] is taking different steps to increase the motivation of students in learning basic C/C++. Image-processing algorithms are used as a means to provide direct visual feedback. Greene et al. [23] report that the U.S. Air Force Academy has transformed the core aerospace engineering course. A separate course for aeronautics majors is now provided that incorporates a minor change in the standard core aero course, while maintaining the standard course for non-aero majors. This has led to greatly improved knowledge and skills provided to the aeronautics graduates while still adhering to the vital core curriculum. Limited assessment indicates the curriculum change is a success.

Cecil [24] provides an overview of Virtual Learning Environments (VLEs) and their use in engineering education at Oklahoma State University. The process of creating such

VLEs is given. A pilot study on the impact of VLEs on student performance shows that there was an improvement in the overall performance of the students.

From two universities in Portugal comes a study on open-ended, problem solving in lighting engineering (Valdez et al., [25]). The work was implemented through group projects using the DIALux 4.7 software package. Students' self-esteem was boosted by this project.

CONTRIBUTION TO SOCIETY AND WORKING WITH INDUSTRY

At the Management Center Innsbruck in Austria, Hillmer et al. [26] have conducted a survey with a standardized questionnaire combined with interviews with over 25 leaders of companies. The results show that there are major deviations between skills expected or required by industry and the actual competencies of engineering graduates. They are developing an engineering education program to address this issue.

From Israel, Sabag et al. [27] strongly advocate adopting reflective thinking in engineering design. Using their 17 years of experience running an internship program for students, they discuss students' reflective thinking as it was forced upon them during system malfunction in design project implementation. The cite examples of students' reflection as revealed in their interviews, project books, and final presentations.

In Denmark, the Copenhagen University College of Engineering (IHK) has embarked upon a plan to develop and implement alternative practices and technological solutions to transform IHK into a sustainable institution [28]. Examples of technical solutions developed by students are presented, with a focus on wind and bio mass energy, energy conservation, and application of cradle-to-cradle concepts in product development and manufacturing.

In a U.S.-Ghana college-industry cooperative research project carried out in Ghana, Sekyere et al. [29] are seeking to address a societal need while also supporting the development aspiration of the country. The medium for the cooperation is research in Power Line Communication, a technology in which data can be transmitted over electric power lines thereby providing Internet connectivity to all areas that are connected to the electrical grid. The Internet brings connection to places such as libraries and research centers for educational purposes as well as access to essentials such as health care, thus serving a major need in Ghana.

The Computer Science School of La Plata University in Argentina is employing community extension and volunteering activities to improve computer science education. The impact of these activities is assessed by Diaz and colleagues [30]. They show the importance of encouraging a sense of social and environmental responsibility through these actions.

During 2006-2008 in the industrial city of Suzuki, Japan, Mori et al. [31] undertook the development of an education program for junior engineers and staff members essential for sustaining the manufacturing capabilities of local small and medium sized companies. The curriculum included lectures augmented by practical training using the machines and facilities at both the Suzuki College of Technology and cooperating companies.

Last but not the least, in Brazil, there is high interest in the government, industry and academia to develop the research and human resources for the energy sector. Udaeta et al. [32] emphasize that there is a need for research and education relating to the production chain of the natural gas and biofuels industries. The features of the human resources program of the Institute of Energy and Electrotechnic at the University of São Paulo are described. The program is a scholarships program for undergraduates and postgraduate students.

ACKNOWLEDGEMENTS

We are pleased to present in this volume a dynamic portfolio of studies that represent but a small segment of the work of the global community. Like its predecessors, *Innovations 2012* attempts to provide a glimpse of the recent innovative, dynamic and diverse accomplishments of the community. As if responding to the exhortations of the keynote speakers in 2009, the authors in this volume have brought forth issues from multiple disciplines in topics that stand at the forefront of contemporary engineering education. We thank these authors, and the reviewers, for their hard work and conscientious cooperation.

We offer this book to them and to members of the iNEER Network as a token of our gratitude for their support, and our best wishes for their continued success in surmounting the lingering global economic crisis.

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