IEEE leaders address UP academics on engineering education

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Do students really learn effectively through attending lectures? Why are student numbers in engineering, specifically electrical and electronic engineering, dwindling in many countries, and how do we go about attracting students to this field of study? Why do we keep working in silos when disciplines are clearly overlapping? And encapsulating these questions, what is the future of engineering education?

These were some of the difficult questions posed by two of the past presidents of the Institute of Electrical and Electronics Engineers (IEEE) and respected academics during their visit to the University of Pretoria in May 2012.

On 22 May, Prof Michael Lightner, Professor and Chair of Electrical, Computer and Energy Engineering at the University of Colorado and 2012 IEEE Vice-President for Educational Activities, and Prof Leah Jamieson, John A Edwardson Dean of Engineering at Purdue University and 2012 IEEE Foundation President, addressed interested students and staff at the Carl and Emily Fuchs Institute for Microelectronics (CEFIM) on the future of engineering education.

Evolution or revolution?

Prof Lightner, an acclaimed electrical and electronics engineer, predicts that engineering education will be dramatically different in as little as eight years' time, as engineering education is facing pressures for change from multiple sources and the boundaries between traditional fields are fading. More and more people are questioning the effectiveness of the way engineering is currently taught, and major prestigious universities, like Harvard in the USA, have already significantly changed their teaching approach.

Prof Lightner spoke about what he sees as some of the main driving forces behind the evolution in engineering education. The first stems from the question "Why do we teach what we teach?" New computational tools are challenging the definition of basic skills and are demanding changes in theory and laboratory classes to reflect modern engineering practices and needs. He questions why engineering educators are teaching subjects as if symbolic computation and computers do not exist. Even though the traditional methods have some merit, why not use large, real-world examples in teaching instead? Data from real sources allow for new, real-world, authentic problems, which give lecturers an opportunity to engage students to a much greater extent.

Engineering is in many ways embedded within other disciplines, yet engineering schools fail to integrate modules of other disciplines into engineering programmes to expose students to the wide range of career options available to them. Data analysis, microscopy, health informatics, biochips, telemedicine and prosthetics are all fields related to the medical industry, of which engineering forms an integral part. Prof Lightner suggests that it is important to find solutions to integrate differing sets of expertise in engineering courses in order to enrich the learning environment for students.

Prof Lightner believes that while engineering education is evolving, a revolution is taking place in the methods used by some universities to teach engineering. The use of online education offers the possibility of higher efficiency and more personalised learning, and challenges the role of the traditional engineering professor.

Engineering education research

Research that looks at the way engineering is taught and at the philosophy behind engineering as a discipline is a field that is growing into a discipline in its own right. Prof Jamieson is one of a few researchers to be leading research in the field of engineering education.

Engineering education is bringing together decades of experience in teaching engineering with more recent knowledge from education and

social behavioural sciences research, to delve into the critical questions mentioned above. "Engineering education is about good research, good teaching, better learning, and overall it is about change that is based on research," said Prof Jamieson.

She also emphasised another key question: how do we connect engineering education research with engineering education practice? Researchers in engineering education look at change in the profession and how to find new, innovative ways to teach, yet the teaching methods used remain unchanged, because the research findings are not communicated to the lecturers and are not implemented.

A couple of universities or engineering schools in the world now have dedicated graduate programmes in engineering education.

Prof Jamieson said that there are many challenges for researchers in engineering education, as it is an emerging field, but adds that it is an exciting and important research field to enter.

As engineering education departments are being established, new curriculums need to be developed, committees and procedures need to be established, and funding needs to be sourced.

About the academics

Prof Michael Lightner is a Professor and Chair of Electrical, Computer and Energy Engineering at the University of Colorado, Boulder, and is the IEEE's 2012 Vice-President for Educational Activities. Among his many awards are the IEEE's Circuits and Systems Society (CAS) Golden Jubilee Medal (2000), the IEEE's Third Millennium Medal (2000) and

the Distinguished Service Award of the IEEE for Serving as Editor of *IEEE Transactions on Computer-aided Design*.

Prof Leah Jamieson is the John A Edwardson Dean of Engineering at Purdue University, Ransburg. She is a Distinguished Professor of Electrical and Computer Engineering and holds a courtesy appointment in Purdue's School of Engineering Education. She is co-founder and past director of the Engineering Projects in Community Service (EPICS) Programme and is the 2012 IEEE Foundation President. She has been recognised with the Gordon Prize of the National Academy of Engineering (NAE) for Innovation in Engineering and Technology Education, the National Science Foundation (NSF) Director's Award for Distinguished Teaching Scholars and the Anita Borg Institute's Women of Vision Award for Social Impact. ⊕