



CREATING A YEARNING FOR LEARNING: INITIATIVES FOR INCREASING STUDENT ENGAGEMENT

2019



UNIVERSITEIT VAN PRETORIA
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Faculty of Engineering,
Built Environment
and Information Technology

INTRODUCTION

The University of Pretoria’s approach to teaching and learning is based on inquiry-based learning, hybrid learning and community-based learning. Its Teaching and Learning Plan is focused on a number of strategies to enhance access and successful student learning. Key drivers to achieving its institutional goals related to teaching and learning include the centrality of the academic mission and the student-centredness of its offerings.

The Faculty of Engineering, Built Environment and Information Technology is committed to student success and achieving world-class teaching and learning outcomes. “It has a progressive strategy in place to address several key priorities,” says Prof Alta van der Merwe, the Faculty’s Deputy-Dean: Teaching and Learning. “These include increasing the Faculty’s overall module success rates, increasing minimum-time completion rates, transforming the curriculum, bringing about transformation through the curriculum, systematically monitoring the implementation of the hybrid model of teaching and learning, and improving the Faculty’s international ranking through teaching and learning practices.”

The Faculty hosts an annual Teaching and Learning Seminar, where lecturers in the Faculty share initiatives for increasing student success – some which worked, and can be emulated by other staff members; and others that were not as successful, but could be used by other colleagues in different situations, having learned from shared past experiences.

This publication features abstracts from the presentations delivered at the seminar in 2019, held at the University of Pretoria’s Future Africa Campus on 30 October 2019. It includes profiles of the presenters, who represent all four schools in the Faculty, and are implementing leading initiatives for increasing student engagement to create a yearning for learning.

Welcoming delegates to the seminar, Prof Sunil Maharaj, Dean of the Faculty, declared that he was invigorated to see the innovations in teaching and learning taking place in the Faculty.

This sentiment was echoed by Prof Norman Duncan, Vice-Principal: Academic, who delivered the opening address at the seminar. He commended the Faculty for foregrounding teaching and learning, stating that the Faculty is setting the trend for teaching and learning at the University. Its initiatives are impacting on what other faculties are doing in the teaching and learning space. He ascribes this to the excellent leadership in the Faculty, as well as the institutional culture that encourages student engagement.

SEMINAR THEMES

1

PLANNED
CHANGES IN
TEACHING
(SURVEY RESULTS)

2

ASSESSMENT
AND FEEDBACK

3

STUDENT
REFLECTION

4

ACTIVE
LEARNING

Keynote address

Prof. dr. Nathalie Charlier

PERSONALISED ADAPTIVE LEARNING

The keynote address at the seminar was delivered by Dr Nathalie Charlier from the Katholieke Universiteit Leuven (KU Leuven) in Belgium. Dr Charlier is an associate professor in the Faculty of Pharmaceutical Sciences and programme director of the Educational Master's degree in Health Sciences. She has participated in several national and international research projects in educational technology and game-based learning and assessment.

One of her research interests is the use of new technologies in education. Her address focused on personalised learning through interactive video. She discussed trends in e-learning, particularly as they relate to the Fourth Industrial Revolution (4IR), and disruptive technologies.

Through personalised adaptive learning, game-based learning can be used to enable students to choose what they wish to learn on an e-learning platform. In this way, students who require background information have access to it, while students with prior knowledge can go straight into the acquisition of new information.

She provided delegates with some advice when using multimedia learning, such as avoiding cognitive overload and presenting new knowledge in small bite-sized chunks. She emphasised the need to manage students' essential processing of new information through their sensory memory (using visual and auditory stimuli), together with sound and images, to deliver an integrated message. In this way, the information has a better chance to be retained in students' long-term memory.



Dr Charlier went on to discuss the advantages and disadvantages of interactive video as a teaching and learning tool. Advantages include the fact that it is self-paced, sustainable, convenient and standardised. Disadvantages include the cost involved, connectivity, instructor effort and learner isolation.

She concluded her presentation with the key elements of interactive learning:

- Incorporate flexibility: allow the students control over the time, place, path and tempo of learning.
- Stimulate interaction: encourage social interaction to ensure more effective communication.
- Facilitate students' learning processes: focus on self-regulation skills such as discipline and time management skills.
- Foster an effective learning climate: contribute to positive, effective learning.





Attending the Faculty of Engineering, Built Environment and Information Technology's Teaching and Learning Seminar 2019 (from left): Dean of the Faculty, Prof Sunil Maharaj, keynote speaker, Dr Nathalie Charlier, Deputy Dean: Teaching and Learning, Prof Alta van der Merwe, and University of Pretoria Vice-Principal: Academic, Prof Norman Duncan.

Preliminary results from a survey of planned changes in teaching

The presentations delivered at the annual Teaching and Learning Seminar were preceded by feedback from Dr Helen Inglis of the Department of Mechanical and Aeronautical Engineering and Carl Sandrock of the Department of Chemical Engineering, who had conducted a survey among lecturers in the Faculty on planned changes in teaching the lecturers considered implementing. The purpose of this survey was to create a culture of sharing and support, and to spark more conversations around teaching, as they believed that reflecting on teaching contributes to developing teaching portfolios, which in turn enhances teaching and learning in the Faculty. The findings of the survey revealed not only changes in module outcomes, but also in assessment, content and mode of presentation. The conclusion they reached was that teaching staff in the Faculty are serious about teaching, and are making a significant effort to help students to learn, understand and succeed. The initial survey will be followed by a second survey that will focus on the positive and negative aspects of change.

Dr Helen Inglis



Dr Inglis is a senior lecturer in the Department of Mechanical and Aeronautical Engineering. After completing her undergraduate degree at the University of Cape Town she worked at the CSIR, performing structural analysis and design on composite and airframe structures. She was awarded a Fulbright fellowship to pursue her postgraduate studies at the University of Illinois at Urbana-Champaign, where she earned both her master's and doctoral degrees, specialising in solid mechanics. Her research is focused on modeling the effect of non-linear material behaviour on aging infrastructure. She has grown her interest in engineering education, with a focus on understanding how students succeed.

Carl Sandrock

Carl Sandrock is a senior lecturer in the Department of Chemical Engineering. His research interest is the interface between computers, process control, and people. As part of his research, he has developed modelling tools for non-linear process simulation, specifically focusing on stochastic simulation. He has supervised several postgraduate projects in collaboration with industry (Sasol, Sappi and Anglo Platinum), where he worked on exploiting process models for better control, understanding process behaviour and augmenting process engineering skill with algorithmic knowledge discovery.



Assessment and feedback



Annique Smith

Annique Smith is a lecturer in the Department of Information Science. She teaches in the Bachelor in Information Science (Multimedia) degree programme. Her research interests are game studies and the use of gamification in higher education. She is currently working towards completing her PhD degree in this field.

Formative feedback through two-stage submission

Annique Smith shared her experience on formative feedback through two-stage submissions, where students had two deadlines: the first to receive formative feedback regarding the project deliverables, and the second for assessment purposes. This gave students the opportunity to process and incorporate the feedback received in order to improve their work for final assessment. She found that the students engaged with these optional deadlines to deliver better outcomes.

Harvesting productive student hours

Prof Nicol presented a recipe for harvesting more productive student hours. This entailed various online preparation tools that are linked to 20 three-hour work sessions. Randomly assigned groups of three students each complete the session tutorial together and then rate each other's work. Each work session was concluded with a 30-minute individual semester test to assess preparation and class participation. It was argued that the recipe resulted in improved understanding of the subject given a fixed time investment, thus increasing productivity.

NRF: B3 rating

Prof Willie Nicol

Prof Nicol is a full professor in the Department of Chemical Engineering. He received his bachelor's degree in Chemical Engineering from the University of Pretoria in 1994, while his PhD was completed under supervision of David Glasser and Diane Hildebrandt at the University of the Witwatersrand in 1998. His postgraduate education was based on reaction network synthesis employing a theoretical approach. Since joining the University of Pretoria in 2001, he has been a firm believer in the balanced approach to Reaction Engineering, where theory without experimental work or experimental work without theory has little merit. He established the Reaction Engineering Group within the Department of Chemical Engineering in 2001, with the majority of research focusing on trickle bed reactors. In 2012, he received the Gold Medal Award from the South African Institute of Chemical Engineers for his work on trickle bed reactors. In 2011, the Reaction Engineering Group converted to the Bioreaction Engineering Group, where the focus shifted to the study of biological reaction processes.



The role of reflection in learning

Prof Wilke discussed the important role of reflection in learning. This is often overlooked, as true learning only takes place once one reflects on what one has learned. The basic premise of reflective learning is that learning does not happen when assignments are done, but once the students reflect on what they learnt by doing the assignment. This shift in focus places emphasis on the conceptual understanding of the curriculum content, as opposed to the mechanistic completion of a task, which leads to critical thinking and actual learning. This requires crafted assignments where each question has a clear purpose and meaning. It also requires incorporating reflective questions into homework assignments to drive the learning momentum towards reflection. He concluded his presentation by reminding delegates that learning is not about finding the right answers, but about asking the right questions.



NRF: Y2 rating

Nico Wilke

Prof Wilke is an Associate Professor in the Department of Mechanical and Aeronautical Engineering. He is a design optimisation and computational modeling researcher in the Centre for Asset and Integrity Management (C-AIM). This includes the optimisation of industrial processes, which requires computationally demanding large-scale analyses on non-standard hardware computers, such as graphical processing units.

Developing an awareness of personal epistemology in a cohort of research

Prof Walwyn reflected on developing an awareness of a personal epistemology in a cohort of technology management research students. This entailed considering how students' personal beliefs impact on their cognitive thinking and reasoning. The challenge was to encourage a level of ontological self-reflection, within which students could be made aware of the limitations of positivism in the analysis of management problems. Changes in his teaching method included the use of an awareness questionnaire and more time for class discussion, which resulted in an improvement in the quality of students' research proposals.



NRF: C3 rating

Prof David Walwyn

Prof Walwyn is a full professor in the Graduate School of Technology Management (GSTM). He received his BSc in Chemical Engineering from the University of Cape Town, and his PhD from the University of Cambridge. His research interests cover sustainability transitions, renewable energy, health economics, science and innovation policy, research management and industry localisation. He currently teaches two courses in engineering economics and a course in energy value chains.

Student reflection



NRF: C2 rating

Prof Warren du Plessis

Prof Du Plessis is a full professor in the Department of Electrical, Electronic and Computer Engineering. He received the BEng (Electronic), MEng (Electronic) and PhD (Engineering) degrees from the University of Pretoria in 1998, 2003 and 2010 respectively. He has been working in electronic warfare and radar since 2006. He is a senior member of the Institute for Electrical and Electronics Engineers (IEEE), a Lifetime Member of the Association of Old Crows (AOC), a member of the AOC Aardvark Roost Board, and a member of the Institution of Engineering and Technology. He is author of 57 published and accepted peer-reviewed journal and conference papers, and is lead or sole author of 32 of these, thereby demonstrating his leading role in developing and evaluating innovative new concepts. While his primary research focus has been cross-eye jamming, Prof Du Plessis has also published on issues such as data reduction, cognitive electronic warfare, and possible approaches to enhancing electronic warfare training.

“It is important to develop a nurturing relationship with students.”

Why students realise I care

Prof Du Plessis asked the question: Why do students realise I care? He focused on the importance of developing a nurturing relationship with students. He described some of the approaches he uses to make students realise that he cares about both the course and the students themselves. This included listening to students' suggestions and providing feedback, developing mutual respect and trust, breaking down the barriers that exist between the lecturer and the student, and encouraging interaction. While he does not consider any of his approaches to be significant in themselves, he concludes that everything lecturers do contributes to students' impression of them as lecturers.





NRF: Y2 rating

Dr Marie Hattingh

Dr Hattingh is a senior lecturer in the Department of Informatics. Before joining the academic community, she served as a Communications Officer in the SANDF before moving to the Kingdom of Saudi Arabia. She is a lecturer for Systems Analysis and Design on an undergraduate level, and Human Computer Interaction on a postgraduate level.

Bridging the gap between theory and practice

Dr Hattingh's presentation explored bridging the gap between theory and practice. In the Systems Analysis and Design module, students often struggle to relate the theory of modelling with its practice. The presentation of theory, tutorial and practical classes in this module was restructured to optimise students' learning experience. This intervention resulted in teaching being concentrated on the modelling tool instead of on aspects related to understanding the theory, which resulted in increased student engagement. Targeted discussion classes based on the concepts taught previously allowed students to reflect on what they had learned, and allowed them to ask pertinent questions on areas with which they experience difficulty.



Dr Nadia Trent

Dr Trent (née Viljoen) is a lecturer in the Department of Industrial and Systems Engineering and coordinator of the Faculty's Vertically Integrated Projects (VIP) programme. She is invested in developing learning opportunities that not only create engineering graduates that are accredited by the Engineering Council of South Africa (ECSA), but also exceptionally useful human beings.

Making money move: Active learning in engineering economics

Dr Trent presented the case of active learning in engineering economics: making money move. She decided to change her approach to teaching the subject of engineering economics by incorporating aspects of active learning, as she felt that engineering economics, when taught in a traditional chalk-and-talk style from American textbooks, can be alienating and boring. However, when made relevant to the realities of students on the threshold of their working lives, it can become life changing. She therefore combined elements of collaborative, experiential and self-guided learning with gamification in order to emphasise the relevance of financial management. She also resocialised her classroom for increased student engagement by changing the way she related to her students. This led to them becoming co-conspirators in discovery.

Active learning



Carl Sandrock

Carl Sandrock is a senior lecturer in the Department of Chemical Engineering. His research interest is the interface between computers, process control, and people. As part of his research, he has developed modelling tools for non-linear process simulation, specifically focusing on stochastic simulation.

Hands-on activities as an aid to understand dynamics and control

Carl Sandrock explained how he made use of hands-on activities as an aid to understanding dynamics and control. The material presented in the modules of Process Dynamics and Control is often abstract with no real-world value. He therefore restructured his course by focusing on small-scale real systems that students can touch and interact with during the tutorials. This provided a more cohesive underpinning to the examples of abstract manipulation by relating the content to students' personal experience rather than theory. This allowed for a more immediate, shared experience of abstract concepts, and resulted in positive feedback from the students.

Interactive learning through gaming simulation in a cross-disciplinary course in civil engineering

Prof Venter discussed interactive learning through gaming simulation in a cross-disciplinary course. The Infrastructure Planning module entails integrated land-use transport planning, and is taught in conjunction with the Department of Town and Regional Planning. A game, called UPTown, was developed as a bespoke application that integrates commercial software with a locally developed interface to simulate the development of a hypothetical town over a 30-year timeframe. Students take on specific roles of either public sector planners or private sector real estate developers. This allows them to explore the problems of conflicting objectives and discover the value of cooperative planning in land use and transport development. An assessment of student performance showed that the game significantly enhanced the achievement of learning outcomes. He believes that gaming simulation can succeed in responding to contemporary engineering students' preferences for more active and social learning styles.



NRF: C2 rating

Dr Christo Venter

Dr Venter is an associate professor in the Department of Civil Engineering. He received his PhD degree in transportation engineering from the University of California, Berkeley, in 1998. His research interests focus on the intersection of transport policy, public transport deployment, and societal impacts within the challenging environment of African cities.

The MARV^{elous} Micros Project

Prof Hanekom introduced delegates to the MARV^{elous} Micros Project. This formed part of teaching related to the microcontroller-based autonomous robotics vehicle (MARV), presented in the Microprocessors module. In an attempt to increase student engagement, she developed an online textbook, which was aligned to the development of a practical project involving robotic vehicles. It was specifically focused on addressing issues at a basic level that students struggle to understand. The textbook was made available in Google Docs, and included the option for live updates based on student feedback. It also introduced a flipped classroom strategy. The approach seemed to have the highest impact on the middle-level students, while the performance of the top students was slightly improved. Unfortunately, the performance of the poor students did not show any noticeable improvement.



NRF: C2 rating

Prof Tania Hanekom

Prof Hanekom is a full professor in the Department of Electrical, Electronic and Computer Engineering. She obtained her bachelor's degree, master's degree and PhD from the University of Pretoria. Her research interest is in bioengineering, cochlear implants and neuroscience. Her research in the electrically stimulated human auditory system aims to create user-specific computer models of the auditory periphery of cochlear implant users with the objective to develop clinical tools to allow non-invasive, model-based diagnostics and the model-predicted customisation of device parameters. She has also developed an interest in engineering education, and has received, faculty, institutional and national awards for teaching and learning. Her main teaching philosophy is that challenge is an effective strategy to develop excellence, especially in engineering students who cannot resist a contest that requires the expression of their technical ingenuity. To accomplish this, she developed a practical component to assessment, which required student teams to develop autonomous line-following robots that compete in a professionally organised Race Day event. This event provides an opportunity to undertake and complete a comprehensive engineering project from first principles, to experience the joy of achievement, and to involve the industry that graduates will eventually sustain.

