FACULTY TEACHING AND LEARNING AWARDS

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UNIVERSITEIT VAN PRETORIA
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YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment
and Information Technology

EXCELLENCE IN TEACHING AND LEARNING

Message from the Deputy Dean: Teaching and Learning

Faculty of Engineering, Built Environment and Information Technology

The University of Pretoria is not immune to the challenges faced by higher education institutions across the globe in the time of the worldwide COVID-19 pandemic.

Among its other consequences, the nationwide lockdown of 2020 that was brought about by the rapid spread of COVID-19 made unprecedented demands on the higher education sector in terms of its important function of teaching and learning. However, the University of Pretoria's lecturers rose to the challenge by adopting innovative approaches of transferring knowledge and ensuring improved academic performance.

In recognition of its lecturers commitment to their students by developing novel teaching innovations, the Faculty of Engineering, Built Environment and Information Technology awards its annual Teaching and Learning Awards. The teaching innovations of the recipients of these awards are captured in this publication.

"In our faculty, we are privileged to have staff members who think innovatively and experiment with new technologies and ways to incorporate better methods of teaching and learning."

Prof Alta van der Merwe

Using student misconceptions as a tool to prompt class discussions and facilitate learning

Elizbé du Toit, a senior lecturer in the Department of Chemical Engineering, has been teaching the same subjects for almost 20 years. She is passionate about teaching and strives to develop innovative methods to explain highly cognitive concepts.

Elizbé teaches Thermodynamics to second-year students (CTD 223) and Reactor Design to fourth-year students (CRO 410). In these classes, she employs a polling software solution called TurningPoint to encourage student engagement. This app enables live polling, whereby students can respond to questions using their smart phones. Software such as this is designed to create engaging and interactive experiences between an audience and a presenter. Although polling is typically used to determine students' understanding of the subject matter after it has been taught, Elizbé uses this method to prepare her students for the coming material.

Her experience in teaching these subjects has afforded her the benefit of anticipating student misconceptions and frequently made mistakes. It is this experience that has led her to understand that clever people do not appreciate being wrong and often try to hide the fact that they do not understand something. Left unchecked, the shame of being wrong can hinder proper learning in a subject that deals with some of the core concepts upon which chemical engineering is built.

The classes start with a hypothesis presented to the students through the TurningPoint app. This is a well-planned, anonymous poll based on a frequently misunderstood concept in anticipation that the majority of the class will get the answer wrong. Although the poll results displayed to the class are anonymous, the students can see that it is normal to be wrong. This helps students to relax about their own knowledge gaps and creates fertile ground for robust discussion. She has received positive feedback from her students about these non-threatening and interactive sessions.

Improving students' grasp of three-dimensional geometry

Three lecturers in the Department of Civil Engineering, Prof Billy Boshoff, Dr Anneke Roux and Dr Phia Smit approached the challenge presented by the first-year Mechanics module (SWK 122) by making use of a new innovation in the Faculty.

Mechanics 122 is a high-impact module, which is presented to almost 1 800 first-year students in the Faculty, as well as some students in the Faculty of Natural and Agricultural Sciences. It is a conceptually difficult module due to the three-dimensional geometry that has to be mastered, and poses a challenge to a large number of students.

In an attempt to increase the student pass rate, the lecturers sought a solution that would save them time when it came to marking the papers, which would free up time to provide the students with constructive feedback, which would in turn improve their understanding of difficult concepts.

The team therefore implemented a system of optical character recognition (OCR) to grade their evaluations.

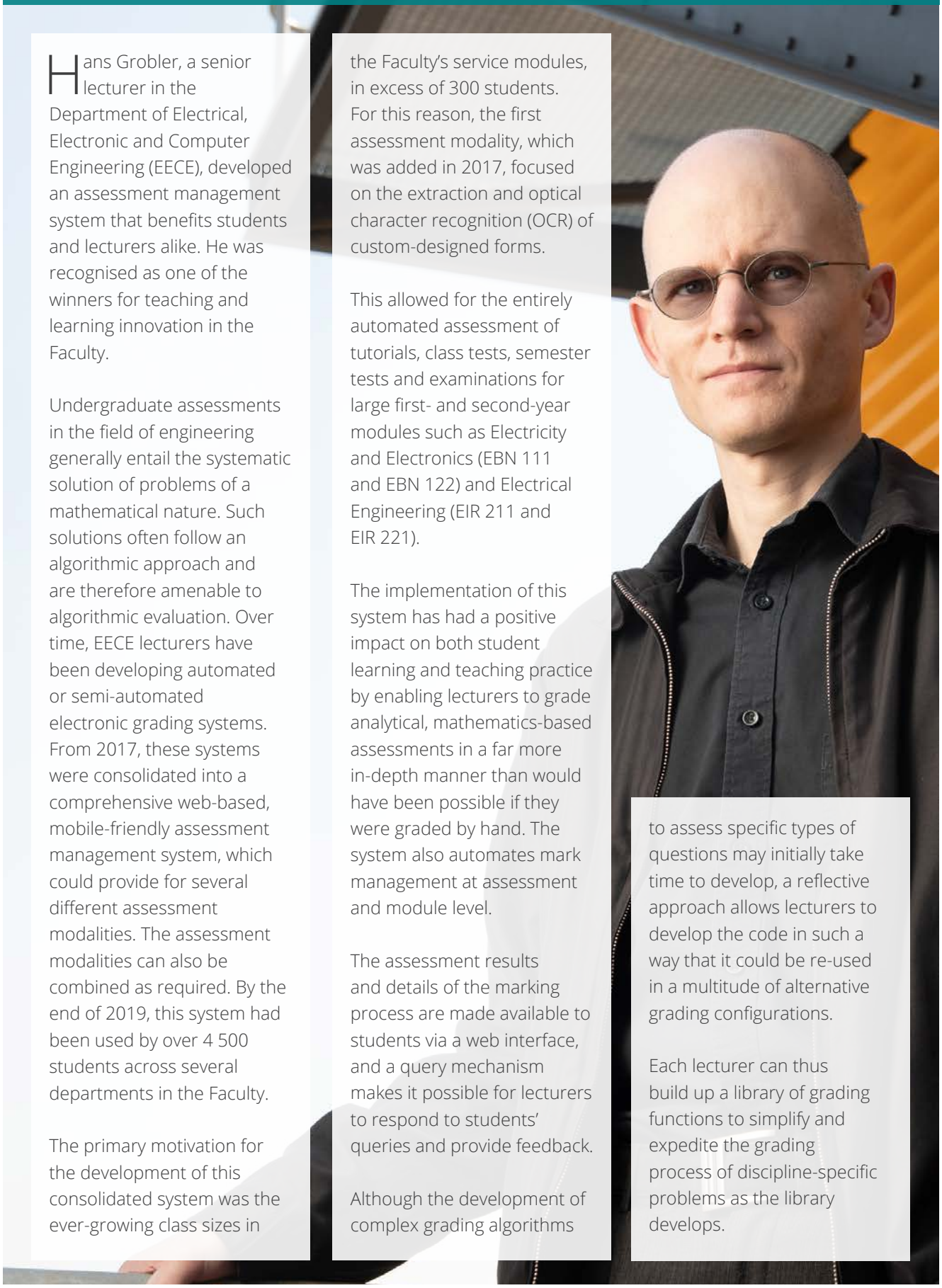
This is the electronic conversion of images of typed, handwritten or printed text into machine-encoded text and is one of the functionalities of the Judicator Assessment Management System (JAMS), which was developed by Hans Grobler of the Department of Electrical, Electronic and Computer Engineering.

By converting the students' answers to machine-encoded text, it was possible for the students' answers to be graded by a computer, thus reducing the time it took the lecturers to complete this task. This made the reinstatement of weekly formative tutorial tests possible, whereby the students could receive weekly feedback. Due to the large number of students, this would not have been possible if these tests had to be marked by hand.

In preparation for the new computer-enabled grading system, the lecturers had to carefully set these tests to ensure that they could be automatically marked. There were some growing pains, as with any new system, but it proved to be a learning experience for both the lecturers and the students. However, the greatest benefit lay in the fact that the students were able to receive weekly feedback on their progress.

The team believes in a student-centered approach to lecturing to facilitate learning rather than just teaching.

An innovative approach to undergraduate assessment



Hans Grobler, a senior lecturer in the Department of Electrical, Electronic and Computer Engineering (EECE), developed an assessment management system that benefits students and lecturers alike. He was recognised as one of the winners for teaching and learning innovation in the Faculty.

Undergraduate assessments in the field of engineering generally entail the systematic solution of problems of a mathematical nature. Such solutions often follow an algorithmic approach and are therefore amenable to algorithmic evaluation. Over time, EECE lecturers have been developing automated or semi-automated electronic grading systems. From 2017, these systems were consolidated into a comprehensive web-based, mobile-friendly assessment management system, which could provide for several different assessment modalities. The assessment modalities can also be combined as required. By the end of 2019, this system had been used by over 4 500 students across several departments in the Faculty.

The primary motivation for the development of this consolidated system was the ever-growing class sizes in the Faculty's service modules, in excess of 300 students. For this reason, the first assessment modality, which was added in 2017, focused on the extraction and optical character recognition (OCR) of custom-designed forms.

This allowed for the entirely automated assessment of tutorials, class tests, semester tests and examinations for large first- and second-year modules such as Electricity and Electronics (EBN 111 and EBN 122) and Electrical Engineering (EIR 211 and EIR 221).

The implementation of this system has had a positive impact on both student learning and teaching practice by enabling lecturers to grade analytical, mathematics-based assessments in a far more in-depth manner than would have been possible if they were graded by hand. The system also automates mark management at assessment and module level.

The assessment results and details of the marking process are made available to students via a web interface, and a query mechanism makes it possible for lecturers to respond to students' queries and provide feedback.

Although the development of complex grading algorithms to assess specific types of questions may initially take time to develop, a reflective approach allows lecturers to develop the code in such a way that it could be re-used in a multitude of alternative grading configurations.

Each lecturer can thus build up a library of grading functions to simplify and expedite the grading process of discipline-specific problems as the library develops.

Learning by doing promotes problem-solving in practical applications

Dr Wilna Bean, a senior lecturer in the Department of Industrial and Systems Engineering, was recognised for the overall impact of her teaching and learning practices in the department, particularly in the third-year Operational Research (BOZ 312) and Industrial Logistics (BLK 320) modules.

Based on previous experience, she approaches the presentation of Operational Research in the first semester from the perspective of developing advanced analytical models to solve actual problems. Through continuous assessment, students can learn by doing. After explaining a concept, students apply it practically by means of assignments and group projects. She attributes the students' success to placing a greater emphasis on practical exercises as part of their assignments, determining why a problem is formulated in a particular manner and how the information that has been obtained can be applied. Students are encouraged to identify an actual problem experienced by a company (preferably the company at which they are gaining their practical experience), and to work on the project and solve the problem during the semester.

Dr Bean has observed how students grow and develop through this problem-solving process. Where they had initially struggled, the extra practice that this approach gives them delivers good results.

In the case of Industrial Logistics in the second semester, the focus is on supply chain management. As this is a very dynamic subject, it is essential that Dr Bean stays abreast of the latest developments in the field. Her approach in this module is to look at the logistics involved in the entire supply chain from an engineering perspective. This makes the University's graduates who have completed the Industrial Logistics module in industrial engineering particularly attractive to prospective employers.

Over the years that Dr Bean has been presenting this module, she has made adaptations based on her observations of students' performance and experience.

Although it contains a lot of theory, which is necessary for application, she emphasises its practical application. Through interactive exercises, case studies and group discussions, the theory becomes more easily

embedded in students' minds. Dr Bean believes that theory can be better understood if students are able to apply it in practice, which is why she includes the practical application of case studies in exam questions as well.

Industry visits and guest lectures are important to give students an idea of what the work of an industrial engineer entails by bringing the industry to the classroom.

Dr Bean also makes use of videos in her lectures to explain how theory works in practice, as well as interactive quizzes to encourage friendly competition between students. This is a further way of embedding the theory, and has received good feedback from the students.

Overcoming the challenges of a high-impact module through a web-based solution

Prof Roelf Mostert, Head of the Department of Materials Science and Metallurgical Engineering, recognised the challenges involved in teaching a high-impact module such as Materials Science to a very large group of first-year students. With more than 1 000 students enrolled in this subject each year, he needed to develop an innovative approach to improve the relatively low throughput.

Since his appointment as Head of Department in 2015, he has been determined to uncover the reasons for this subject being classified as a high-impact module (characterised by high class numbers and a pass rate below 70%). After interviewing students and lecturers, the fact that the material presented in the first year of study is new to the students, and that it contained concepts that had not been covered at school level, appeared to exacerbate the problem. In particular, the students identified the great leap between high school science and university-level engineering, coupled with other challenges linked to university study.

He therefore investigated several interventions that could be utilised; most notably, the WileyPLUS web-based companion. This option gave students access to videos that were available 24/7 with problems that students had to solve. It also contained 3D images of concepts and how they work. The benefit of this interactive element was that students could adapt it according to their needs. A further advantage was that this option included a mechanism to generate and mark class tests, and to generate variables that facilitated continuous assessment so that students could see which elements they were struggling with. During the tutorials that formed part of this option, students could also ask questions about these elements or they could watch the video again to clarify any difficulties.

Having identified this web-based companion as a possible solution to the difficulties experienced by students, Prof Mostert had to determine the most cost-effective manner of incorporating it into the curriculum. Initially, students had to purchase the companion at an additional cost to their tuition fees, but in 2018, Prof Mostert managed to negotiate its inclusion in their fees.

Prof Mostert conducted focus group research to determine the success of this application. Students' reflection on the support they received through this solution was found to be very positive. Although the module had still not reached its targeted throughput rate, the students' marks indicated an upward trend, which can be attributed to the application's online tutorial classes.

Teaching engineers to think beyond the math

Prof Schalk Kok, Professor in the Department of Mechanical and Aeronautical Engineering, drives the notion that application far surpasses calculations in the real world of engineering among his students. He teaches Structural Design (MOW 227) to second-year students, which introduces them to the principles of design.

In an ever-changing world brought about by rapid developments in technology, static textbooks take far too long to be updated to incorporate the latest developments.

In addition, the current cohort of students comprises young people who think visually and learn through practical application.

To promote active learning in this module, experiments become an essential teaching tool.

Prof Kok believes that the engineers of tomorrow need to be pushed further than ever before to come up with innovative solutions to industry problems. In practice, when a student is admitted to study engineering, it can be accepted that he or she is already capable of performing complex calculations with the help of mathematical formulae. However, the important distinction relates to whether the student can use the answer to make decisions. In industry, graduate engineers will be required to think beyond the math to design structures with integrity and which are fit for purpose.

To prepare students for the challenges they will face in their careers, Prof Kok requires them to design and build their own experiments to master the textbook material, rather than giving them "plug-and-play" activities.

This gives students the space to make mistakes in an environment that is free from real-world consequences.

For their design experiments, students are given access to software within which the relevant formulae have already been programmed. This removes the focus from mathematical calculations, and places it rather on the interpretation of results and its implications for design. This practice tests students' knowledge of the module content, rather than their ability to accurately substitute numerical values into formulae.

Given the current challenges faced by higher education in terms of teaching and learning, Prof Kok's method of individual experimentation also has the potential to work well in distance learning.

"Back to basics" is the secret to his success

Prof Francois Malan, Associate Professor in the Department of Mining Engineering, is an internationally recognised specialist in Rock Engineering, and his final-year Rock Mechanics students are certainly benefiting from his expertise. This specialised subject is an essential component of the work of a mining engineer, and his unique teaching approach has been acknowledged by his students, who consistently give him an excellent rating as a lecturer upon conclusion of each semester. Prof Malan describes his approach as "back to basics". As such, he identifies five specific elements that form part of his innovative approach to teaching.

Firstly, he believes that a lecturer needs to be enthusiastic in order to engender enthusiasm about the subject in their students. If the lecturer is enthusiastic about the subject matter, students will grasp the bigger picture and realise the importance of the theoretical concepts that are being taught in terms of their eventual work as a mining engineer.

Secondly, he emphasises the importance of using local examples to illustrate the concepts that are being presented. This highlights the relevance of the theory that is being taught, and makes students aware of the fact that the information being conveyed has its origin in real life. By updating the study material with practical examples of historic and recent mine disasters, Prof Malan encourages students to view mine risk assessment as more than just a theoretical exercise, and to put themselves in the shoes of the mine manager to identify ways to prevent similar disasters in the future.

Thirdly, he identifies the significance of spending personal time with his students. Through small classes (between 18 and 40 students) and tutorials, he is able to give each student personal attention, and not to intimidate them. In this way, they are not afraid to ask questions or to request difficult concepts to be explained again.

Fourthly, he considers the importance of making each student feel valued. By appreciating each student's contribution, no matter how small, he is providing them with the confidence they need to work together in a group, which is a soft skill they will need when they enter industry.

His final message is: "Practice, practice, practice!" By applying what has been taught over and over again, students are able to internalise the subject matter until it becomes second nature. And of course, this is reflected in their final marks.

Prof Malan notices an improvement in his students' performance at the end of the semester, and believes that his five-part teaching approach is the secret to his success as a lecturer. He also notices how his students demonstrate personal growth through the course of the semester, and how they start asking more intelligent questions, which illustrates their grasp of the subject matter.

Supporting students to cope with the academic demands of tertiary study

Dr Ruric Vogel, a senior lecturer in the Additional Chemistry modules for first- and second-year engineering students in the Engineering Augmented Degree Programme (ENGAGE), focuses on problem-solving by breaking difficult content up into manageable chunks. With a PhD in both Organic Chemistry and Psychology, he is perfectly suited to guide first-year students who need help to cope with the academic demands of university study.

ENGAGE is a five-year undergraduate programme that provides a carefully structured curriculum to help students adjust to university life and cope with the challenges related to engineering studies. In this programme, the volume of work is gradually increased, while the support provided is gradually decreased over a period of three years. The students work in parallel with the mainstream students, but in smaller groups, with classes seldom exceeding 50 students. They attend a theory lecture once a week, followed by practice classes three times a week, with a greater emphasis on application, where the essence is isolated and problem areas identified.

This programme is mainly chosen by students who face challenges related to an inadequate background knowledge in Mathematics and Physical Science, academic literacy and information technology, and who may not have effective study skills to cope with the mainstream four-year programme. The students who follow this programme benefit from Dr Vogel's unique approach to teaching, and are able to join the mainstream programme from their second academic year of study.

Central to his approach to supporting students to cope with the academic demands of tertiary study is his commitment to his students. He enjoys working with people, and cares for his students. As such, he has a good rapport with them, which helps give them the confidence they need to approach him with problems they might experience with the subject content. He also believes that it is important to get to know the individual behind the person sitting in front of him in the classroom. Dr Vogel also finds that students are better able to grasp the theoretical nature of Chemistry if he presents it to them in the form of an analogue or a metaphor.

Finally, he emphasises the importance of recognising one's identity. As a lecturer, he is of the opinion that teaching must be part of one's essence: it must be who you are. In a similar vein, he encourages his students to determine whether they identify with being an engineer, which is an important element in ensuring their academic success.

Setting the tone for the discovery of spatial design

Dr Nico Botes, a lecturer in the Department of Architecture, was the Department's finalist for the Faculty's Teaching and Learning Award for 2019. His nomination was based on his role in convening selection for the Department's coursework programmes and coordinating its undergraduate programmes, which includes the programmes of architecture, interior architecture and landscape architecture. He was recognised for his innovation and continued leadership in the education of first-year students in the disciplines of spatial design.

Illustrating Dr Botes's approach to teaching and learning, his colleague, Johan Prinsloo, who co-presented the Design module with Dr Botes, reflected as follows:

"For ten years, we toiled together in the dramatic theatre of design teaching – the first-year studio – where I witnessed Nico's intuitive ability to stage the scene for students to flourish as individuals. Their robotic expectation for rote learning and narrowly defined outcomes is erased every January as they step into the dark – literally – where Nico directs them to draw with candles on white paper to the rhythms of music from across the world. The perplexing act of drawing invisible lines in darkness to strange sounds – later to be revealed with paint as beautiful patterns – sets the tone for a year of discovery that remains, for most students graduating from the Department, their most memorable experience.

"He designs projects as encounters to be experienced, rather than problems to be solved; he engaged in whole-body and hybrid learning long before these became common pedagogic jargon. Students are enthused to participate through Nico's animated bass voice that gathers up a diverse range of current-day and cultural references, even in local dialects, that relate the academic content to every student's own background – from the suburbs to the townships, from the city to the platteland. These encounters are choreographed to take students through a series of steps across the year that shifts awareness from the self to the other, from the body to the city, and from the known to the unknown."

Bringing the benefits of social media to the classroom

Faith Dowelani, a lecturer in the Department of Construction Economics, was acknowledged for her approach to the teaching of Quantities to second-year students in the BSc (Quantity Surveying) programme. As this subject entails measuring simple buildings and simple building elements and external works, as well as abstracting and billing, it is a vital component in preparing graduates to work as a quantity surveyor.

Although students are introduced to this subject in their first year of study, she found that many students are unfamiliar with the building elements that they are required to measure. This presents difficulties when it comes to explaining the actual techniques involved in estimating the quantities of materials involved in construction. The interpretation of 3D images in real life into 2D images in drawings also appeared to be challenging to some students.

To overcome these challenges, she investigated existing education technologies in use at other universities globally to identify an option that could be applied to the local built environment industry. She found the technology platform Edmodo to be the most applicable to her students. This is an educational website that takes the ideas of a social network and refines them to make them appropriate for use in the classroom. This allows an identified educational community to learn together from anywhere with an all-encompassing learning management system.

It is a coaching platform that enables teachers to share content, distribute quizzes and assignments, and manage communication. Her students could therefore chat to the lecturer, and she could upload images and videos to complement the course content. This also addressed the challenge involved in applying theory to practice.

As she presented each new section in the curriculum, the students could find examples of the elements they were measuring from the drawings that were uploaded onto Edmodo. This platform also enabled increased interactivity, as students could upload their own images and discuss examples between themselves and with the lecturer. It also enabled her to provide assistance with the interpretation of drawings.

A marked improvement in the students' marks was observed by the end of the semester.

Simplifying research methodology for final-year students

Kundani Makakavhule, a lecturer in the Department of Town and Regional Planning, was acknowledged for her teaching approach to make potentially difficult and unknown concepts more accessible to final-year students in the Research Methodology module.

This is a compulsory subject for all students in the Department to prepare them for their final-year research project. It approaches the contextualisation of a research problem, how to conduct a literature review, the theory behind research design and research methods, undertaking empirical research in line with an approved research proposal, collecting, analysing and interpreting data, and writing up research findings.

As this is something town and regional planning students have not yet encountered in their undergraduate curriculum, she found that she needed to make it more accessible to them. She therefore set out to simplify the topic. Her approach was to make students see research as an everyday task. She made them realise that they are involved in scientific enquiry in everything they do, and should regard data collection as the task of finding out more about things, rather than a step in the research process.

She asks her students to determine whether there are rules that can assist one in knowing something, or whether one can make one's own rules. Their everyday lives are filled with knowledge, and she embraces an approach of co-learning and the co-production of knowledge between the students and the lecturer. She also focuses on local case studies in the context of the South African built environment to make the theory more tangible to students.

In the first introductory lecturer, she usually finds that the students are unwilling to engage, which causes her to use a technique she calls provocation. With this technique, she encourages them to consider how they would go about finding information about (researching) an everyday topic. They often admit that they would follow a logical approach, based on their personal knowledge and experience. This opens the way for her to apply practical examples to the theory of research methodology.

She has received positive feedback from her students on this teaching approach, and the students' performance has also been good. She therefore intends to continue with this approach of the co-production of knowledge, and to explore other techniques that will enhance teaching and learning in town and regional planning.

Module revisions lead to improved student performance

Dr Nils Timm, a lecturer in the Department of Computer Science, was recognised for restructuring the first-year Operating Systems module (COS 122). He took over responsibility for this high-risk module in 2019, which had an enrolment of about 600 students. It exhibited a poor student performance as it had previously been a second-year module, but was moved into the first-year syllabus without making the necessary adaptations.

Before the start of the semester, he formed a task team of lecturers and education consultants to determine the reasons for the low pass rates and to identify possible changes that could be made to the module. Students who repeated the module were involved in the evaluation, as they could provide feedback on the reasons why they had previously failed it, and why they found the module to be particularly difficult in comparison to other modules. All the module's previous instructors and lecturers were also involved in the evaluation, and their opinions were obtained as to why this module had become a high-risk module.

Based on the outcomes of the evaluation, Dr Timm adapted the course content by reducing the number of textbook chapters presented in the lectures, which allowed the lecturer to discuss fewer topics in greater detail. He also changed the form of assessment by replacing the programming practicals with homework assignments. This was necessary as first-year students have not typically acquired the necessary programming skills yet. They only obtain these during the course of the year. Finally, he introduced additional student support sessions such as tutorials and bootcamps, and ensured that the examination questions were better aligned to the exercises the students did in their tutorials and the tasks that they had to solve in their homework assignments. The students were therefore better prepared for the examination.

After the first quarter of the semester, Dr Timm conducted a classroom survey of student engagement. The feedback already showed that the measures to restructure the module were well received. This allowed Dr Timm and his team to make adjustments in the module for the remainder of the semester based on the students' suggestions. This included an enhanced alignment of the different teaching and assessment activities.

The overall measures resulted in a significantly improved pass rate in comparison to previous years and in high student satisfaction. These interventions will be continued in the future presentation of this module to ensure ongoing success.

Integrating BA BOT as a knowledge conversion strategy

Dr Marié Hattingh, a senior lecturer in the Department of Informatics, spearheaded the development of a knowledge conversion platform in the form of a BA Bot in the second-year Informatics (INF 271) module to create an environment of continuous learning. She was recognised as one of the winners for teaching and learning innovation in the Faculty, and qualified as a finalist in the University's institutional Teaching and Learning Award.

In the Information System Design (ISD) stream, in which she lectures second- and third-year students, she applied her teaching philosophy of continuous learning (for both lecturers and students) to create an environment in which students are not just acquiring content knowledge, but are also developing graduate attributes and a professional skill set. One of the initiatives she used to create a continuous learning environment was to create BA BOT – a knowledge conversion platform for ISD students to access content and feedback on ISD topics.

The idea of a knowledge conversion platform was born from Dr Hattingh's own need to note information that was not captured in any textbook, but was required to complete the third-year (INF 370) capstone project. This platform was initiated through the integration of a commercially available BOT platform and Google Drive. It allowed her to improve the INF 271 curriculum by making available authentic case studies that suited not only the teaching strategy of the Department, but were easily accessible and contextualised within the South African environment. It could also be continually updated as more relevant case studies became available.

The knowledge conversion model ensured that BA BOT was populated with content to support scaffolded learning, starting at the data level, where key concepts and definitions were explained, and working up to integrated examples. This platform enabled the teaching team (comprising the coordinating lecturers, assistant lecturers and teaching assistants) to provide students with various learning activities that cater for the different types of learning required by the context (notes,

tutorial activities and additional resources, including videos) so that students can learn at their own pace. It also has the functionality to provide feedback, which is essential for effective learning.

Dr Hattingh sees students as individuals who are part of an ecosystem or learning environment that is influenced by a number of factors that need to be taken into account. She also believes that the most important outcome of learning is the development of industry-ready graduates.

Learning communities facilitate academic success through emotional support

Prof Marlene Holmner is an Associate Professor in the Department of Information Science. She lectures in the first-year Information Science module (INL 110), which is compulsory for students from all three of the Department's degree programmes – Information Science, Publishing and Multimedia. During her years of teaching this module, Prof Holmner has come to learn that the emotional wellbeing of first-year students can have a significant impact on their academic performance.

To support first-year students in the process of adjusting to university life and the academic demands that come with it, Prof Holmner has spearheaded the establishment of departmental learning communities. These learning communities are facilitated using the group chat feature on WhatsApp. Some 30 to 35 students are placed on a group chat, along with a module tutor. The instant interactive platform has proven itself to be ideal for communicating with students in a more personal manner.

The purpose of these learning communities is multi-faceted, addressing both the students' academic and emotional needs. Students are, for example, reminded of due dates for assignments, while also receive messages of encouragement from the module tutors. Features such as "emojis" streamline the process of determining students' emotional state, whereby each student can quickly indicate feelings such as anxiety or stress, or indicate that they are coping. The platform also open lines of communication by encouraging question-and-answer exchanges.

To ensure no misuse of the platform, supervision becomes an essential component. In this regard, Prof Holmner oversees the group chats, which also allows her to anticipate any problem areas in the module.

During exceptionally stressful times, the learning communities enable the Department's support structures to intervene with relevant measures to promote the emotional welfare of the students. The learning communities have been embraced by both staff and students in the Department.

International collaboration paves the way to enhance postgraduate teaching

Prof Elma van der Lingen is Head of the Department of Engineering and Technology Management in the Graduate School of Technology Management (GSTM). As it is a postgraduate school, Prof Van der Lingen plays an important role in supporting teaching and learning at postgraduate level, particularly in entrepreneurship studies.

The importance of entrepreneurship studies has increased significantly with the realisation of their importance for economic growth. As a result, entrepreneurship courses can no longer only be offered in business schools and faculties of economic and management sciences; they should increasingly be incorporated into programmes in natural sciences and engineering faculties.

This realisation led to research to determine the enterprising tendency of science, engineering and technology (SET) students with the General Enterprising Tendency (GET) test developed by Dr Sally Caird. SET students were found to have an above-average enterprising tendency, which indicates that they are likely to be enterprising in some way, but most likely through intrapreneurship by being part of a group within a corporate environment. It was also found that SET students' first undergraduate degree does not appear to have any influence on their enterprising tendency. Male students were found to have a higher enterprising tendency than female students, and males in the BTech degree revealed a significantly higher need for autonomy than females. White students were more inclined to display entrepreneurial traits, while black students displayed a higher need for achievement.

This research was presented at an international conference, and led to a collaborative project between the GSTM and two Norwegian universities: Nord University Business School and Western Norway University of Applied Sciences. This gave rise to two papers published in *Education and Training* in September 2019 and July 2020, respectively. The first paper, "Developing engineering students' willingness and ability to perform creative tasks" explored creativity and how it changes over time among engineering students in practice-based entrepreneurship in higher education.

The second paper, "The relationship between entrepreneurial experience and preferred learning styles" illustrated that entrepreneurship is a learning process that incorporates a cumulative series of multifaceted entrepreneurial experiences, which generally involve the development of new insights and behaviours. As such, the study aimed to determine whether entrepreneurial experience has an influence on the preferred learning styles of students.

The outcomes of this research will contribute to the way in which technopreneurship courses are structured to provide more effective training for science, engineering and technology students.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