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Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Theknolotši ya Tshedimošo

Faculty **Teaching and Learning** Awards

Teaching:
anywhere,
anytime

Message from the Deputy-Dean

Teaching and Learning

T&L

The demands placed on the higher education sector, and contact tuition, in particular, continued in 2021 as the country entered its second year of restrictions in accordance with the President's COVID-19 Risk-adjusted Strategy. As it had already established a solid foundation of hybrid learning, the Faculty of Engineering, Built Environment and Information Technology could build forth on the successes it had achieved in 2020.

Despite the turbulent times our lecturers and students have experienced since the start of the pandemic, our teaching staff continued with their activities in an online environment. Many of them adopted creative approaches of transferring knowledge, thereby achieving improved academic performance. The approaches lecturers utilised included the flipped classroom approach, where students completed pre-class activities at home and worked on live problem-solving tasks during class time, asynchronous and interactive videos, and synchronous lectures via Blackboard Collaborate.

In recognition of its lecturers' commitment to their students, the Faculty presents its annual Teaching and Learning Awards. The teaching innovations of the recipients of these awards are captured in this publication.

While online teaching is not without its challenges, many lessons have been learnt, which can extend the reach of universities and make education accessible to more people. The most prominent challenge experienced relates specifically to South Africa's unique problems of access to technology and overcoming the digital divide.

The Faculty's future approach to teaching and learning may well incorporate elements of online learning. This will entail utilising the advantages of contact tuition, while enhancing the benefits of technology. For example, the recording of lectures, as an initiative instituted in online teaching, has proven to have additional benefits. These lectures are not only viewed later when students have access to the internet or a convenient location, but enable students to revise course content. This approach received such positive feedback that the Faculty is considering its continued application.

Another initiative that succeeded in improving student performance was the institution of continuous assessment. Many lecturers made use of this approach to ensure that no student was left behind during online tuition. The enhanced results suggest that it might be beneficial to continue with this practice.

However, the focus on digital communication has brought about a challenge of another kind. This is the emotional and psychological wellbeing of our students and staff. Several lecturers focused specifically on this issue in the teaching approach they decided to adopt as part of online tuition. This will continue to form an important part of the Faculty's teaching strategy.

In retrospect, it is clear that the challenges we have faced in recent years have propelled us into a space where we can truly embrace teaching innovation. The Faculty remains dedicated to reconceptualising the Future of Work to the benefit of our students, enabling them to make a meaningful impact on our world.

Prof Alta van der Merwe

CHEMICAL ENGINEERING

Social interaction brings meaningful learning

Senior lecturer in the Department of Chemical Engineering, **ELIZBE DU TOIT**, has spent years getting to know how students learn. Fundamental to this process, in her experience, is student engagement.

Du Toit subscribes to the social constructivist learning theory; credited to Lev Vygotsky, a 20th-century Russian psychologist. This theory views human development as a socially mediated process. It states that people acquire knowledge through collaborative dialogue with more knowledgeable people – referred to as the "more knowledgeable other".

For knowledge transfer to take place between the student and the more knowledgeable other, interaction needs to occur through mediation. This process allows students to appropriate the cognitive tools that make the construction of knowledge possible by doing activities or tasks that they cannot do on their own. In keeping with the principles of the social constructivist learning theory, mediation happens in the Zone of Proximal Development (ZPD). According to Vygotsky, the ZPD is a social space that only opens through interaction.

Du Toit has been applying the concepts of social constructivist learning theory to her second-year class in Thermodynamics, as well as her fourth-year class in Reactor Design. Teaching and learning activities for these modules have been compiled through the use of scaffolding to allow students to navigate the ZPD. Scaffolding is a form of assistance that allows the students to solve a problem, or carry out a task, that would be beyond their abilities given the lack of access to a more knowledgeable other in the ZPD.

In building the module content, differentiated scaffolding was introduced, recognising that not all students require the same amount of scaffolding to complete the knowledge transfer. Continuous formative assessment activities were developed to monitor student learning and provide ongoing feedback at a point in time when the student would still have had the chance to improve their skills and understanding before undergoing summative assessment.

Formative assessment takes the form of online tests with intentional immediate feedback. For each study theme, the students have to solve a "big problem", which comprises a scenario with lots of information, the big question, and smaller questions.

The first level of scaffolding breaks the big problem down into smaller questions that attempt to lead the student through the process on the "how should I think about this problem" path. Further scaffolding is then provided through the use of immediate automatic feedback options.

The assessments allow for multiple attempts, and contributed to a small percentage of the students' grades. This reduces the risk and anxiety associated with the typical test scenario, and allows students to continuously improve their understanding without the high stakes of summative assessment.

Du Toit expressed that her experience of the level of student interaction has made her confident that this method is one that she will continue to implement in her teaching, whether she is required to teach online or in person.

CIVIL ENGINEERING

Opportunities beyond the classroom benefit online learning

PROF JAMES MAINA, a professor in the Department of Civil Engineering, is involved in teaching a very challenging second-year module in the School of Engineering: Strength of Materials (SWK 210).

This module is not just followed by Civil Engineering students, but also by students in Chemical Engineering and Mining Engineering, as well as students from departments in the Faculty of Natural and Agricultural Sciences, such as Geology, and Engineering and Environmental Geology. With its focus on the mechanical properties of materials, as well as their responses to external loading in terms of stresses, strains and deflections, this module needs to teach students to think abstractly and in three dimensions.

According to Prof Maina, the secret to doing well in this module lies in a single word: "practise". With the transition to online learning, Prof Maina investigated ways of providing students with additional opportunities beyond the classroom to gain even more opportunities to practice, on their own, in this challenging subject with its difficult concepts. He, therefore, partnered with the publisher of the subject's prescribed textbook, which provided students with online learning materials, including videos on its website.

It also made an online textbook available to students. An important functionality of this textbook was that, while self-studying, students could only proceed to the following chapter once they had mastered the basic principles of the previous one. Students who had not fully grasped the content would be guided to go back to certain parts of the material. The online learning material had several additional benefits, such as allowing students to progress at their own pace if they felt the class was moving too quickly, while students who were quick to grasp new content had the opportunity to move ahead with the material.

After making use of the online textbook, students were given individual assignments for assessment, which made a small contribution to their semester marks. In addition to the online learning material, Prof Maina gave students more class examples that he solved on Blackboard Collaborate through ClickUP. To confirm their understanding of the subject matter, students were also given questions through which they would work on their own during tutorial classes, where tutors were on hand to assist if students got stuck.

The online textbook was supplemented by live online lectures, which were recorded for the use of students who were unable to attend the lectures at the scheduled time. The benefit of these live lectures was that students could ask questions and receive the answers immediately.

Prof Maina found that this approach improved students' interest in the subject, as well as their confidence in asking questions. The success of the online textbook has prompted Prof Maina to continue with this supporting resource in the future.

CIVIL ENGINEERING

Students' performance is improved through hybrid learning

KARIN JANSEN VAN RENSBURG, a lecturer in the Department of Civil Engineering, found that combining elements of online learning with traditional methods of teaching and learning led to an improvement in students' marks in the final-year Civil Engineering Management programme (SEV 421).

This module involves several crucial elements of civil engineering management with which graduates will be confronted when they enter the profession. These include aspects related to the regulatory framework, site investigation and restoration, and waste disposal. An important part of the regulatory framework includes integrated environmental management processes and South Africa's environmental legislation, as well as the application of ISO 140 000: Environmental Management. Other topics that are broached include community participation, municipal service delivery life cycles, environmental management in the context of the project life cycle, and safety, health, the environment and quality in the workplace.

This is an important module for qualifying civil engineers as the structures and facilities that these professionals plan, design, construct, maintain and demolish or rehabilitate have a long lifespan with a direct impact on both man and the environment. Civil engineers need to be able to deal with the analytical aspects of design, and liaise and consult directly with communities and individuals to design, build and maintain infrastructure cost-effectively to the benefit of mankind.

In the transition to online learning, Jansen van Rensburg encountered several problems that needed to be addressed to ensure student success. The most significant related to the fact that almost a third of the class experienced challenges joining online classes due to internet access. A hybrid approach proved to be more feasible, and also delivered better results.

To overcome these issues, Jansen van Rensburg resorted to video recording her lectures. She went through the work in detail during a two-hour session, which students who were able to access at the scheduled time could attend, while students who were unable to do so could watch them later. Another benefit of this approach was that students could watch the session again if there were aspects they did not understand immediately and needed to revise. Jansen van Rensburg made provision for students to email questions to her that came up while watching the video, which she would discuss during the following session.

Although this approach proved to be successful, Jansen van Rensburg admits that it made assessment more of a challenge.

ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

How to build circuits online

DR SUZANNE SMITH served as a senior lecturer in the Department of Electrical, Electronic and Computer Engineering, teaching electricity and electronics to first-year students in the Department through the EBN 111 and EBN 122 modules. These modules aim to teach students to solve electric and electronic circuits using both direct current (DC) and alternating current (AC) sources. The skills that students learn in these modules form the fundamental building blocks for their studies in this field. As such, it is essential for students to master the module content during their practical sessions.

In the past, the EBN modules comprised in-person practical sessions and tutorials. These served as a platform for students to build circuits by hand, thereby gaining an understanding of the theoretical aspects through practical implementation. This works exceptionally well, since students are supported by teaching assistants who look over their shoulders to identify any problems and misconceptions. The in-person sessions also give students the opportunity to get to know their teaching assistants, which encourages them to ask for help.

With the transition to online learning, Dr Smith had to consider what would be the most appropriate approach to follow with her students in this new environment. She recognised the fact that the practical composition of circuits would still have to form an integral part of the module presentation to enhance student understanding.

Her incorporation of virtual laboratories and simulated circuit platforms during lockdown periods compensated for the lack of in-person sessions to ensure that students still had the opportunity to build and test their circuits during their practical sessions. Dr Smith employed TinkerCAD Circuits to facilitate the practical sessions in a virtual environment.

Tinkercad is an online 3D modelling program that runs in a web browser. It is therefore accessible to students from anywhere with internet connectivity. The platform allows students to design, program, simulate and build circuits in order to ensure that they understand the work. During module tests, students were provided with randomised parameters to ensure fair assessment of the skills that they had mastered.

In addition to the simulations completed online, component kits were sent to students to encourage them to practice their virtual skills on physical circuits. Although students were encouraged to engage with the component kits to enhance their understanding of the subject matter, the physical circuits were not submitted for evaluation.

The lessons learnt through this experience can be used to supplement the modules' practical component in future – specifically when students have to complete their work from home.

INDUSTRIAL ENGINEERING

Creating a sense of similarity in online learning

DR WILNA BEAN is a senior lecturer in the Department of Industrial Engineering. Her teaching interest is in supply chain management and optimisation. She was involved in teaching Operations Research at third-year and honours level, as well as the undergraduate Supply Chain Management module, in an online environment in 2021.

When faced with the challenge of replacing face-to-face lectures with online learning, Dr Bean decided to adopt a creative approach so as not to lose her students' interest and attention. Her approach was to ensure that her online classes contained a sense of similarity so that students would not feel alienated. She wanted to maintain a rapport with her students, and allow them to feel that they could approach her with any problems they might be experiencing. She therefore designed her virtual lectures in the form of live online classes, in which she created a classroom atmosphere. These were recorded for students who were unable to participate at the scheduled time due to challenges posed by the online learning environment.

Since the optimisation models formulated in the modules require a specific mathematical notation, which is too complex to properly demonstrate on Blackboard Collaborate's whiteboard, and students generally struggle to use the correct notation, she also used pencasts to record the formulation of these models by hand in the correct format and with the correct notation (exactly as she would have done on a whiteboard or chalkboard). She then played these pencasts during her live lectures, while explaining the model logic.

These online classes included an element of an actual face-to-face teaching situation so that the students could feel that they were in the classroom on campus. Her classes therefore resembled the typical "chalk-and-talk" situation, where she would explain the concepts to be covered in the syllabus and host discussions with the students who were present. She also offered the option of a video consultation to maintain contact with her students.

Dr Bean made use of breakout groups during the online classes as well, which gave students the opportunity to discuss certain concepts among themselves, and then come back for a feedback session. This approach received much positive feedback, as it ensured that the transition to online learning took place with minimal disruption.

The classes were presented once a week, and were supplemented by the discussion board function on ClickUP, where she would ignite a conversation on a particular topic, and encourage students to answer each other's questions and respond to comments. She monitored these responses twice a day so that students could receive feedback while their concerns were still fresh in their minds. She also supplemented her live online lectures with pre-recorded video lectures where problems were modelled and explained. This allowed students to work though examples on an ongoing basis, and helped them prepare for upcoming lectures and revise concepts after lectures.

MATERIALS SCIENCE AND METALLURGICAL ENGINEERING

Bringing the textbook to life

VINOD KURUP is a lecturer in the Department of Materials Science and Metallurgical Engineering. He teaches Materials Science to first-year students. The students find this subject particularly complex as it requires a combination of their knowledge in the fields of physics, chemistry and mathematics. Up to this point in their academic careers, first-year students have had to deal with the subject matter of these three fields in silos – and typically struggle to link the module content bearing all factors in mind.

In addition to this, first-year engineering students typically find themselves in classrooms with large student numbers. This exasperates the problems that students experience, many of which stem from them feeling too shy to ask questions in front of so many fellow students. The large-scale shift to hybrid teaching and learning has made great strides in minimising problems arising from students' low confidence levels in large physical classes, but has brought with it a myriad of new challenges. One of these is the near-archaic characteristics of the printed textbook.

To support his students, Kurup advocated for a subscription to the WileyPlus platform for the Department's NMC 113 and NMC 123 modules. WileyPlus is an online teaching and learning system that integrates the digital textbook with supplementary resources to enhance the teaching and learning experience. This online environment helps Kurup's students make sense of the module content through videos and additional examples for difficult problems. In this way, the online environment lends itself to repetition, which helps students master the work, even when they initially struggle to understand it during class.

Based on their experience with physics, chemistry and mathematics in high school, first-year students will typically prepare for their module test by working on past papers. Kurup highly discourages this, as it fails to encourage students to take ownership of the methods that the module seeks to teach. The WileyPlus platform allows for diverse, multi-dimensional content that allows students to approach practical engineering problems with the theoretical knowledge that they have acquired.

Kurup has been using the WileyPlus platform since 2019, and has seen an improvement in student marks over the past two years. This is a very promising result that stems from the extensive development work that has taken place in the Materials Science modules. Through this strategy, Kurup hopes to help his students develop their problem-solving skills and think as engineers.

MECHANICAL AND AERONAUTICAL ENGINEERING

One-of-a-kind course turns theory into practice

PROF MOHSEN SHARIFPUR, a professor in the Department of Mechanical and Aeronautical Engineering, has a particular interest in computational fluid dynamics (CFD). This is an important field in mechanical engineering that enables engineers to mathematically model a physical phenomenon involving fluid flow based on the conservation of mass, momentum and energy.

Engineers normally only encounter software to simulate CFD when they start working in industry or when they engage in postgraduate research. Since there was no undergraduate course introducing students to CFD tools, Prof Sharifpur decided to develop such a course for students at the University of Pretoria (UP). Unless graduates continue with postgraduate studies, they will work with CFD tools without having studied the theory underlying the software, or having applied the theory in practical simulations.

With Prof Sharifpur's vast industry experience, he is ideally suited to translating this theory into practice, ensuring that mechanical engineers with an undergraduate degree from UP are a step ahead of their peers when they start working in an environment that requires them to make CFD simulations.

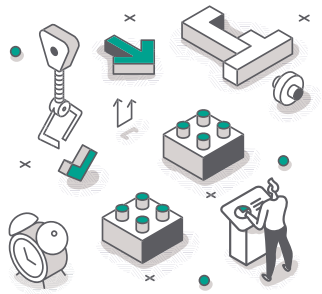
During 2021, Prof Sharifpur also encountered the challenge of transitioning to online learning. He made use of recorded lectures, which he supplemented with pdfs of the lecture slides, that were posted after the class. His opinion is that a hybrid approach works best.

The challenge for Prof Sharifpur, however, came in during the assessment of students who were completing their examinations online, where it could not be ensured that students were not working together to answer questions. To make sure that the answers to mathematical equations were each student's own, original work, Prof Sharifpur generated several different question papers, with up to 20 individual case studies on which students had to base their calculations. This implied that there were basically 20 different exam papers. These question papers were randomly assigned according to student number, so no student knew who else would be getting the same exam paper.

He undertook a similar practice in the case of multiple-choice questions, where he compiled 100 different questions, randomly assigned for different case studies. This was a very time-consuming exercise, which illustrates Prof Sharifpur's dedication to ensuring that each student's output could be fairly evaluated. It also reflects his concern for his students' progress and ability to master difficult content that is necessary to prepare them for the future world of work as an engineer.

ENGAGE

Applying engineering skills within a framework of conceptualisation, design, implementation and operation



LAUREN FOUCHÉ, a lecturer in the Professional Orientation module for engineering students in the Engineering Augmented Degree Programme (ENGAGE), is passionate about science communication. She took a unique approach to the development of the capstone project of this module utilising limited specific LEGO® components. Students had to use these components to construct a crane that could lift 2.5 kg over a distance of 15 cm in 90 seconds following the conceive, design, implement, operate (CDIO) project framework.

Prior to the move to online learning in 2020, students were required to work in pre-selected teams to build the crane while applying the skills and practices they had learnt during the year. However, with the restrictions imposed on face-to-face teaching and learning, the building and testing phases of the project had to be reconsidered.

The main objective of the Professional Orientation module is to lay the foundations for the development of soft skills such as effective communication, teamwork and time management. The project therefore requires students to draw on engineering concepts they have been taught in other modules, and to communicate the operation of their design concepts by means of a written proposal and an oral presentation. This provides the students with exposure to different forms of communication at different stages of a project.

Over the course of four weeks, the student groups are expected to formulate a concept, develop a detailed design and report back on the process, as well as the success or failure of their designs. As the students could not develop their concepts into a physical LEGO® crane in the online learning environment in 2021, they were given the opportunity to use the same limited LEGO® components assigned in previous years in Mecabricks, a free online LEGO® design program, which would introduce them to the concept of detailed design.

Each phase of the CDIO framework was clearly defined and introduced, and students were required to consider the theoretical development of the crane prior to its eventual construction. This provided them with their first taste of what it means to be an engineer through an elementary design project that required them to measure the dimensions of their crane, and calculate its speed and potential lifting capacity. Their lecturers in Additional Physics and Additional Graphical Communication were available to provide assistance, and each step in the process included self and peer evaluations.

The students benefitted from the creation of a microcosm of an engineering environment that served as the culmination of the theory they had learnt during the year.

TOWN AND REGIONAL PLANNING

Teaching with CARE

PROF KARINA LANDMAN is an Associate Professor in the Department of Town and Regional Planning who teaches students at various academic levels. In her teaching activities, Prof Landman strongly believes in finding a balance between the incorporation of knowledge systems from both the North and the South. In this regard, she incorporates the notion of CARE when presenting her classes. The CARE approach facilitates each stage of learning to accommodate different ways of knowing and understanding among students from diverse backgrounds.

In this acronym, the "C" denotes compassion for students. An academic environment that encourages compassion gives students a voice with varied understanding, backgrounds and experiences from across the world. The "A" denotes availability, which is essential for developing channels of learning between students and teachers. Open channels of learning promote inclusivity and the free flow of knowledge.

In Prof Landman's approach to teaching and learning, the "R" denotes repetition and real-life experience. This is an excellent way of cementing the five stages of learning, as adopted by Prof Landman in her approach. These comprise the following:

- Preparation, which provides direction and background for new learning
- Acquisition, which introduces new material through the formation of new, weak synaptic connections that must be strengthened before learning can occur
- Elaboration, which requires students to engage in the learning process explicitly and implicitly, and receive feedback, thereby strengthening the synaptic connections and developing complex neural pathways to connect subjects in meaningful ways
- Memory formation, which provides a space for new knowledge to be internalised, and for students to build their confidence in their new knowledge
- Functional integration, which ultimately allows students to express what they have learnt in new settings (for example, in tests and examinations)

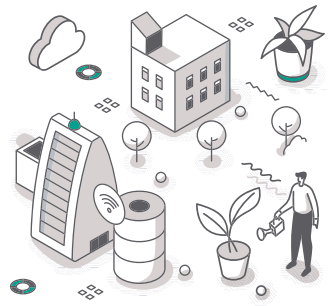
It is the teacher's responsibility to express care and compassion when determining in which stage each student finds themselves, without judgement. Thereafter, the teacher can evaluate what still needs to happen for a student to get to the functional integration stage of learning on an individual basis.

From there, the CARE method demands continuous encouragement ("E").

This strategy works particularly well in studio settings, where teachers have the opportunity to get to know their students, as well as in groupwork activities, where students get to learn from each other. It also requires small class sizes to facilitate opportunities for individual attention. Prof Landman expressed her excitement at the year-on-year growth she witnesses in her students resulting from the CARE method.

ARCHITECTURE

Providing experiential learning opportunities in an online environment



KAREN BOTES is a lecturer in the Department of Architecture who is translating her research passion into an experiential learning opportunity for third-year students specialising in landscape architecture. She believes that students learn best by adding real-life experiences to their theory through multidisciplinary collaboration. Her teaching has enabled her to transfer her interest in sustainable design and novel approaches to the creation of green infrastructure, and to enhance ecosystem services through design.

The teaching and learning initiative for which Botes received the Faculty's Teaching and Learning Award for 2021 started as an innovation in 2020 for the third-year Plant Science module (PWT 322). This module emphasises plant community conservation based on ecological principles in the urban environment, including the technical aspects of planting in these complex environments. During the Integrated Design examinations in the previous year, she identified a gap in students' ability to apply the theory they had learnt in practice. Her approach was therefore to address these knowledge gaps through student-centred, experiential learning.

In 2020, Botes received a Scholarship of Teaching and Learning (SoTL) Grant from the Department of Higher Education and Training (DHET) for a project titled "African food crops in living wall systems". To assist students to gain a better understanding of the learning outcomes of PWT 322, she exposed them to two real-life projects in which green principles were implemented to support ecosystem services: one on the Menlyn Maine precinct in Pretoria East and the other at the University's Future Africa Campus. She also included a real-time case study to attune students to the local context through the planting of African food crops on the Future Africa Campus in two different typologies of green wall systems.

However, the lockdown regulations that were imposed to manage the COVID-19 pandemic compelled Botes to reflect on what she wanted her students to achieve online. This led to a collaboration with the Faculty's Head Education Consultant, Dr Adriana Botha, who provided a different perspective on how to achieve set outcomes in the online environment. This, in turn, led to the application of novel teaching and learning methods.

Botes made use of her SoTL Grant to purchase a 360° camera, which enabled her to make use of Blackboard's interactive video function. By recording the construction of projects that showcased green infrastructure, the students could witness the process virtually, which assisted

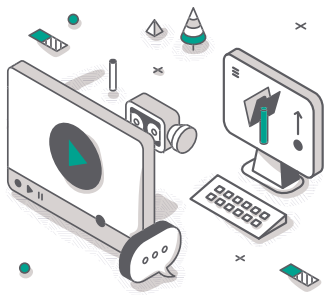
them in understanding the module outcomes as an alternative to physical site visits. Students also collaborated with each other and the lecturer through a WhatsApp group.

The activities that formed part of this initiative required the students to conduct research and present their outcomes to their peers through ClickUP. In the process, Botes was able to create an awareness of African food crops and the role of designers in addressing the United Nations' Sustainable Development Goals (SDGs) in the South African context.

Botes alternated between teaching methods to keep learning vibrant, and included the flipped classroom model, case studies, experiential learning, asynchronous and interactive videos, cross-disciplinary discussions and synchronous lectures via Blackboard Collaborate.

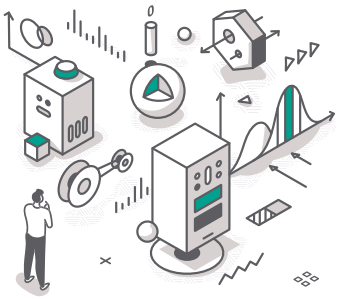
Botes facilitated student learning by engaging her students in four intentional activities to achieve the module's learning outcomes. The first activity entailed real-time online interviews with suppliers, horticulturalists and landscape technologists to discuss different living wall systems. The various professionals introduced the students to different prototype living wall systems. This enabled the students to develop an insight into the benefits and disadvantages of each system. The second activity involved students reflecting on their experience in teams, where each team had to investigate a different prototype of a modular living wall system. Botes divided students into groups, which comprised a mixture of students on different academic levels. The groups were required to conduct research and compile the technical specifications of each system, and analyse the resilience, sustainability, economic feasibility, social benefits and provision of ecosystem services in the South African context. The third activity entailed a discussion between different student teams, where they debated the advantages and disadvantages of the different systems. The fourth activity was the students' examination assignment. Here the students had to implement what they had learnt by selecting a constructed wetland, living wall or rooftop garden system to enhance ecosystem services as part of their design project. This was followed by constructive feedback from the lecturer.

Finally, Botes held project workshops, followed by online engagement with each student on a one-to-one basis, to ensure that the learning outcomes were fully achieved. Due to the small number of students enrolled for this module, she was able to pay personal attention to each student, thereby focusing on their wellbeing, which is vital in a creative learning environment.



CONSTRUCTION ECONOMICS

Introducing novice students to industry concepts in an online environment



INGE PIETERSE, a senior lecturer in the Department of Construction Economics, had to overcome the challenge of introducing first-year quantity surveying, construction management and real estate students to the subject of Quantities in a fully online environment.

Quantities is traditionally a challenging module as students have not been exposed to any of its concepts at school level. Students are introduced to the methodology and techniques that are used to generate tender documentation for built environment projects, which involves the integration of the correct writing methodology, the ability to interpret two-dimensional drawings in a three-dimensional world, and the mastery of standardised measurement rules.

As a foundation module for quantity surveying and construction management, the content for each year of study builds incrementally on the next without repetition. The standardised measurement rules encompass 27 trades distributed across each year of study.

The first year covers earthworks, part of concrete, formwork and reinforcement, part of masonry, part of waterproofing, plastering and paintwork, which enable students to measure simple building elements. The trades introduced in the second year enable students to measure a complete simple building, while those introduced in the third year make provision for the measurement of high-rise buildings and complex concrete structures. The techniques that are taught require students to adequately describe the measurable item to support successful pricing, and to demonstrate the correct unit of measurement. They are also required to record dimensions correctly and accurately.

"In previous years, we presented face-to-face practical lectures and students had hard copy drawings, worked examples and their textbook, *Standard systems of measuring building work,* at their disposal", Pieterse said. "The shift to online teaching was particularly daunting at first-year level to ensure that solid foundations continued to be laid."

The first online attempt, supported by the use of a pdf drawing, work example in MS Excel, supplementary notes in MS Word, the textbook on the side and a PowerPoint presentation was not all that successful.

To overcome difficulties such as display challenges and the problem of moving from one application to the next, the separate resources were discarded and integrated into a single PowerPoint presentation using a two-content layout in each slide. The first content area featured the particular item and the measurement rule, while the second provided the description of the item and its dimensions.

"This enabled me to utilise Blackboard's tools to highlight exactly what part of the illustration I was referring to and what specific dimension accompanied it," explained Pieterse. This guided focus resulted in a much-improved throughput for the module.

INFORMATICS

Solving an industry problem through the development of a business system

DR LIZETTE WEILBACH AND DR MARIE HATTINGH are lecturers in the Informatics 370 module. This module focuses on the application of systems analysis and design in a practical project, programming and the use of computer-aided development tools. The culmination of the module is a capstone project, which brings together all the knowledge the students have gained in their first three years of study.

The project entails the development of a business system for an actual client to solve an industry problem. This enables the Department of Informatics to produce industry-ready graduates who have mastered certain technical skills, are able to work in teams, and have leadership skills, creativity and adaptability.

According to the course coordinator, Dr Weilbach, the students work in teams for a real-world client, who must work through and sign off on each of their deliverables to solve actual problems by analysing, designing, developing and implementing a solution that supports the client's real-world problem. "In the process, we expose the students to the pressures of working in teams, practising their leadership skills, resolving conflict, adhering to strict deadlines and managing their time between the project and their other academic and social commitments."

The lecturers focus on three important aspects: fostering student engagement, stimulating intellectual development and building student rapport. In 2021, 185 students worked in 37 student teams of five students each to complete 12 deliverables in their projects' life cycle.

These included a project proposal, functional and technical specifications, a prototype, the internally tested system, the final system documentation, user and training manuals, a team video introducing the groups, their clients and their solutions, a project repository to showcase their systems, and an exhibition at the Department's annual Project Day. Examples of projects conducted included a food manufacturing and point-of-sale system for a frozen food manufacturing company, an emergency rescue inventory management system for paramedics, and the development of a music centre management system for a private college.

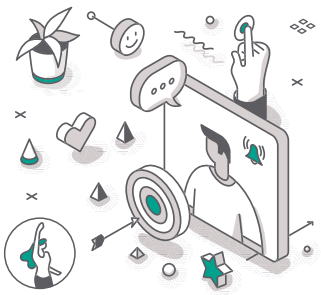
Dr Hattingh, who joined Dr Weilbach to present this module in 2021, says that completing the capstone project online presented a number of challenges, as lecturers had to improvise the way they consulted, provided feedback, assessed and showcased the students' work to industry.

However, the success of the virtual project day showed that the time and effort had paid off.

This programme is one of the only of its kind in South Africa, and an important outcome is the Department's excellent reputation in industry, which leads to almost all its students obtaining employment upon graduation.

COMPUTER SCIENCE

Ensuring student wellbeing during online learning



DR LINDA MARSHALL is a senior lecturer in the Department of Computer Science. She is the Programme Coordinator of the BSc Computer Science degree, which provides both depth and breadth in computing skills, equipping students with problem-solving abilities and giving them a foundation for continued learning in an information technology (IT) career and for producing high-quality software.

This programme strengthens the kind of thinking that needs to be done when developing software. It also provides the basis for research in computer science, which often relies on a certain level of mathematical skill and maturity. It furthermore enables graduates to pursue a career as a programmer, systems analyst, systems architect, consultant, database administrator or network analyst.

With the transition to online learning, Dr Marshall had to consider what would be the most appropriate approach to follow with her second-year and honours students in 2021. She recognised the fact that the nationwide lockdown was accompanied by human isolation, which impacted on students' wellbeing. She did not want to contribute to this lack of social interaction in her online sessions.

Dr Marshall therefore decided not to present her classes by means of asynchronous videos, but rather to present live online lectures, in the same way as she would have done if students had been present in the classroom for physical lectures. This enabled her to listen to her students' problems and provide them with personal interaction. It also enabled live discussions to explain any challenges the students were experiencing with the course material. For students who were unable to attend the classes at the scheduled time due to any issues related to the online learning environment, a recording of the session was made available afterwards. This gave students the opportunity to view the lecture again if there was any aspect they did not fully grasp the first time.

Her online sessions included annotated slides and the running of software programs to illustrate and apply aspects related to building databases and modelling software. She also made use of continuous evaluation to ensure that no student was left behind. If this evaluation revealed that students did not fully understand any aspect of the work, she was able to revise it.

Dr Marshall believes that this approach contributed to her students' emotional wellbeing during the time of COVID-19.

MULTIMEDIA

Promoting increased creativity and the freedom to explore

ANNIQUE SMITH is a lecturer in the Multimedia degree in the Department of Information Science. Her interest lies in the effective use of gamification in flipped classroom environments. She coordinates the first-year Multimedia module, IMY 120 (Multimedia for the Web), which teaches students to design multimedia content using various authoring tools.

The BIS Multimedia degree teaches students to design and create effective multimedia technologies as a means of moving beyond the traditional text medium. Students start by learning to create basic websites according to the latest web standards, and later extend this knowledge to create complex, dynamic websites.

The IMY 120 module focuses on learning specific software to create new visual, audio and multimedia content. Its position near the start of the BIS Multimedia degree means that it teaches students to leverage the Adobe software packages for future projects. This means that a student should not only know how to use a particular tool in Adobe Photoshop, but should understand how that tool might be pushed to its limits, allowing them to create something new and interesting. Therefore, in addition to learning four new software packages (Adobe Photoshop, Illustrator, Audition and Animate), students also learn to step out of their comfort zones to immerse themselves in the process of creating new and beautiful content. This is a core skill for a BIS Multimedia student to master.

According to Smith, her focus for IMY 120 in 2021 was to implement changes to the course to enable students to be more creative in their approach to designing multimedia content. Students were given meaningful choices through open-ended assignments and projects with real-world applications.

A risk-taking, creative culture was encouraged through the use of two-stage submissions, personalised feedback for each student and the showcasing of student work on the Multimedia blog. The module's assessment criteria were redesigned to give credit for showing that students had spent time iterating over their design to improve it.

A constructivist approach to learning was followed by giving students the opportunity to explore and apply what they had learnt to real-world contexts. Students were given choices in how they approached assessments, along with personalised feedback and the opportunity to try and fail without negative consequences. This made room for the iterative, creative process to flourish. A safe, risk-taking environment was fostered and students' success was celebrated.

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