Faculty Teaching and Learning Awards 2022

TEACHING FOR THE FUTURE OF WORK

UNIVERSITEIT VAN PRETORIA
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YUNIBESITHI YA PRETORIA

Faculty of Engineering, Built Environment and Information Technology

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

PROF ALTA VAN DER MERWE

"The Faculty's teaching and technical support staff have embraced the culture of excellence that is so firmly entrenched across all fields of study at the University of Pretoria."

MESSAGE FROM THE DEPUTY-DEAN: TEACHING AND LEARNING

In recognition of its commitment to its students, the Faculty of Engineering, Built Environment and Information Technology presents its annual Teaching and Learning Awards. This year the Faculty boasted joint winners: the team from the Faculty of Electrical, Electronic and Computer Engineering, and Prof Carin Combrinck from the Faculty of Architecture. They were also selected to represent the Faculty in the University's corporate Teaching and Learning Awards.

Despite the challenges posed by the third year of restrictions on citizens of South Africa, including the University's students and staff, due to the COVID-19 pandemic, staff members continued to come up with innovative solutions to overcome the limitations that this brought about.

As the University had already established a solid foundation of hybrid learning, the Faculty could build forth on the successes it had achieved in 2021. I am proud of our academics and technical support staff, who adopted creative approaches of transferring knowledge, thereby maintaining excellent academic performance.

The approaches that were utilised went beyond the methods that had been used in the previous two years, where students completed pre-class activities at home and worked on live problem-solving tasks during class time, or participated in synchronous lectures via Blackboard Collaborate. These approahces included the integration of domains to challenge students in the implementation of their practical projects, integrating urban citizenship into the curriculum, and exposing students to classes in the metaverse.

The focus on digital communication has brought about a challenge of another kind: the emotional and psychological wellbeing of our students and staff. I was delighted to observe that several lecturers focused specifically on this issue in the teaching approach they adopted as part of online tuition. This will continue to form an important part of the Faculty's teaching and learning strategy.

I was also pleased to note that the Faculty's teaching and technical support staff have embraced the culture of excellence that is so firmly entrenched across all fields of study at the University of Pretoria.

This is illustrated in their adoption of the approach of teaching and learning the UP Way. This entails students actively constructing their own knowledge and understanding of the course content through the use of inquiry-based teaching. This includes developing ideas, exploring consequences, justifying solutions, engaging in discussions and solving problems.

I was also particularly pleased to see lecturers making sure that students who needed to complete practical assignments were accommodated while observing the need to maintain social distancing protocols. Without these interventions, many students would not have been able to complete their programmes under the problematic circumstances that prevailed.

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.

At the beginning of the second semester of 2022, we joined the University in welcoming our students back on campus for face-to-face teaching and learning. We believe that we have learnt several valuable lessons over the past few years that we look forward to taking with us into the future to benefit our students and academics.

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.

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Cover: The Faculty's co-winners from the Department of Electrical, Electronic and Computer Engineering. From left: Prof Tinus Stander, Prof Derik le Roux, Prof Trudi Joubert, Dr Werner Badenhorst, Pieter Roodt, Prof Ian Craig, Prof Tania Hanekom and Willem van Jaarsveld.

ELIZBÉ DU TOIT
CHEMICAL ENGINEERING

LEARNING FROM THE TEACHINGS OF EDUCATIONAL PSYCHOLOGY

The experience of senior lecturer in the Department of Chemical Engineering, Elizbé du Toit, is that engineering educators often find themselves believing that they need to discover a new approach to teaching to succeed. Upon reflection, and after some exposure to the very well-established field of educational theory, she came to realise that it may be a worthwhile exercise to read a few chapters based on research in the field of Education.

"It was thanks to my colleagues in the Chemistry Education Research Group (CERGies), who invited me to attend their bi-monthly meetings, that I discovered the psychological theory that explained the difficulties I had been experiencing in two of the undergraduate modules I was teaching: second-year Thermodynamics and final-year Reactor Design," she explains. After applying cognitive load theory (CLT) to her teaching, a whole new world of understanding opened up to her students.

This theory was developed by John Sweller, an Australian educational psychologist, in 1988. Du Toit believes that many aspects of CLT changed the way she thought about teaching and learning (also her own learning). "As teachers, we don't need to re-invent the wheel! We can build on the shoulders of giants: from Socrates to Dewey, and Sweller."

In both the courses she teaches, she attempted to integrate the use of engineering software or tools in the form of "relatively simple" Python code. The aim of CLT is to develop a particular graduate attribute, while allowing students to apply it to subject-specific knowledge. "I often heard pleas from students about "their code" or "their Python" not working, only to discover that they were not implementing the subject-specific problem-solving strategy correctly. This was resulting in coding errors."

Through well-researched case studies, CLT clearly explains that combining a skill in a subject field with a high cognitive load often results in the poor retention of both the subject-specific knowledge and the skill. Du Toit explains her understanding of the theory as follows: "Make sure that students master the subject-specific knowledge and the skill separately. Do not expect students to immediately apply the skill to content with a very high cognitive load, where they already have to work through several steps to reach a solution. First allow for the chunking of knowledge, and then bring in the "tool" you want to use." Du Toit started applying this theory in her second-year Thermodynamics module, and she believes that it made a difference in the students' marks.

Although many descriptions of CLT are available in the literature, the version she found the easiest to digest was that summarised by Oliver Lowell in the book *Sweller's cognitive load theory in action*. "This source provides an excellent summary of the theory. Although it is mainly written for high-school teachers, I found the content and examples very applicable," she remarks.

TECHNICAL TEAM
CIVIL ENGINEERING

From left: Jan Vermaak, Johan Scholtz, Jaco Botha and Vanessa Doman

PROVIDING PRACTICAL SUPPORT IN THE LABORATORY

When it came to supporting students during the restrictions put in place to limit exposure to COVID-19, it was not just the teaching staff that had to come up with innovative solutions to ensure that students achieved academic success. The Faculty's support staff also had to develop new approaches to support students with the completion of their practical assignments.

This was nowhere more clearly illustrated than by the technical team in the Department of Civil Engineering's Concrete Laboratory in Engineering 4.0, as well as the Heavy Machinery Laboratory on the Hatfield Campus. This indispensable team comprised Johan Scholtz, Jaco Botha, Jan Vermaak and Vanessa Doman. They were responsible for managing the practical experiments Civil Engineering students had to perform for their final-year research projects. This component of the undergraduate curriculum determines whether candidates graduate at the end of the year.

According to Prof Wynand Steyn, Head of the Department of Civil Engineering at the time, managing the experimental work for the final-year research project is a challenging effort under normal circumstances. The team had to optimise the use of the available facilities, while ensuring that the students had an opportunity to complete their experimental work.

They therefore developed a system to allow all 256 eligible final-year students to conduct their laboratory work in a safe and healthy environment, while adhering to tight timeframes. Johan Scholtz recalls how the team had to arrange meetings and schedule testing slots for no more than five students at a time to adhere to the social distancing requirement, thoroughly sanitising each work station and piece of equipment after use.

"Proper planning and thorough discussions beforehand to determine exactly what the students wanted to accomplish, and what instruments they would need to use was vital," said Vanessa Doman. Jaco Botha also recalls how the technical team had to organise and help the students plan and execute their experimental work. "When we went into full lockdown, we had to send the results of their experiments to the relevant students so that they could interpret the data and finalise their projects without returning to the lab. This was especially challenging."

Reflecting on the success of the intervention, Jan Vermaak remarks that the elements of planning and coming to the laboratory with a clear understanding of what one wants to achieve will have a longer-term effect. "These elements proved so effective that we will continue to apply them, even when the students return to campus full-time."

Prof Steyn believes that the team's planning and dedication ensured that the Department's academic staff could focus on the challenges of online teaching and learning in the knowledge that their students were effectively managed and well looked after in the laboratory. This supported the Department's teaching and learning efforts substantially.

T&L TEAM
ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

From left: Prof Trudi Joubert, Pieter Roodt, Willem van Jaarsveld, Prof Tinus Stander, Prof Derik le Roux, Prof Ian Craig, Dr Werner Badenhorst and Prof Tania Hanekom.

THE SPONTANEOUS AND ORGANIC GROWTH OF AN INTEGRATED CURRICULUM

A team across the three domains of electrical, electronic and computer engineering succeeded in combining their talents to develop a unique intervention for students to apply what they had learnt in an engaging and a stimulating way across several modules.

This team, which was the joint winner of the Faculty's Teaching and Learning Award for 2022, taught several modules in the Department's curricula. The team comprised Prof Tania Hanekom (third-year Microcontrollers), Prof Trudi Joubert (second-year Digital Systems and third-year Analogue Electronics), Prof Tinus Stander and Dr Werner Badenhorst (third-year design modules), Prof Ian Craig and Prof Derik le Roux (third-year Control Systems), Pieter Roodt (the Robot School) and Willem van Jaarsveld (EBIT Robot Race).

This integrated initiative had two objectives: to provide world-class engineering education to enable students to make a meaningful contribution to addressing local and global challenges through technology; and to spark an interest in electrical, electronic and computer engineering among learners.

The initiative had its origin as early as 2013 when Prof Tania Hanekom developed a project-based learning initiative known as the EBIT Robot Race. Students had to work together in small groups to design and build a microcontroller-based autonomous robotic vehicle. The outcome of the project was for the autonomous vehicle to navigate a coloured line laid out to purposefully cross over other coloured lines and not veer off course, in the shortest time possible.

In 2015, Prof Trudi Joubert identified a potential alignment opportunity between the design of an analogue sensor system and the embedded system facets of the robotic vehicle, particularly as the third-year Analogue Electronics module runs concurrently with the third-year Microcontrollers module, in which the Robot Race was being presented at the time. At the same time, second-year Digital Systems students were introduced to a practical assignment in which they had to design a rudimentary navigation strategy for a robotic vehicle, and implement this strategy on the programmable component platform. This was in anticipation of the design and implementation of the robotic vehicle to be built in their third year.

The impetus for the current intervention occurred in 2020 with the advent of the COVID-19 pandemic. As students could not come to campus, they received component kits with which to build their robotic vehicles. A staffing shortage also led to the combination of individual design modules for electrical, electronic and computer engineering. Prof Tinus Stander then approached Prof Hanekom about using the contextual framework of the microcontroller-based autonomous robotic vehicles to teach engineering system design in the Department's third-year design modules. This provided the perfect opportunity to implement a new level of integration.

In the Department's third-year design modules, the design of the robotic vehicle was split into three separate subsystems, and a software hub was written to allow the remote integration and testing of the individual subsystems. Each of the subsystems targeted a specific discipline, although the three programmes (electrical, electronic and computer engineering) had sufficient background to master the design challenges associated with all the subsystems.

Another module that had to find an emergency hands-on home-based alternative to laboratory-based work during the pandemic was the third-year Control Systems module presented by Prof Ian Craig and Prof Derik le Roux. This module runs concurrently with the design modules.

According to Prof Hanekom, the logical approach was to piggyback on the design module hardware by using the microcontroller-based autonomous robotic vehicles as the plant to be controlled. Students were therefore asked to implement a rudimentary control system, similar to the one required in the Microcontrollers and Design modules, while they had to analyse the robotic vehicles to design and implement a sophisticated proportional integral derivative control system for the Control Systems module. This allowed cross-module comparison between different control system strategies to develop a deeper understanding of the behaviour of control systems implemented at different levels of complexity.

In 2021, while pandemic conditions were still prevailing, the EBIT Robot Race was taken online in the Microprocessor and Analogue Electronics modules. Dr Werner Badenhorst joined the design modules with the responsibility to build on the foundation that had been laid in 2020. His mandate was to review and amend the practical challenge so that students could reiterate the design of their robotic vehicles from a systems engineering perspective, instead of simply repeating the experience from the previous semester.

A new dimension was introduced to the traditional EBIT Robot Race challenge when students had to connect two types of sensors to the same hardware platform. This was done to satisfy the requirements of the Control Systems module. "The project in its present shape is being refined," said Prof Hanekom. "It is now in its third iteration, and is reaching maturity."

A further outcome of this initiative has been its utilisation as a community engagement initiative in the Faculty to encourage school learners to follow a career in science, technology, engineering and mathematics. A project such as the EBIT Robot Race provides the ideal platform to drive social change, and alter the perception that engineering is predominantly a male career. This led to the founding of the Robot School in the Department.

Second-year students can use this platform to teach robotics to school learners as part of the community work they are required to perform as part of their curriculum. Pieter Roodt is managing and driving the development and implementation of this programme, which has the added advantage of exposing students beyond the Department of Electrical, Electronic and Computer Engineering to the principles of robotics.

PROF JOHAN W. JOUBERT
INDUSTRIAL AND SYSTEMS ENGINEERING

HANDS-ON LEARNING ENABLES DECISION MAKING UNDER UNCERTAINTY

Johan W. Joubert is a professor in the Department of Industrial and Systems Engineering and a member of the Faculty's Centre for Transport Development. In an endeavour to prepare students for their final-year research project, and subsequently to feel comfortable working with large data projects in industry, he introduced third-year students in Industrial Analysis and Simulation Modelling to actual data sets and hands-on learning to practically appreciate and understand what it means to develop models that support industry and government when making decisions under uncertainty.

Prof Joubert believes that students learn best when they understand the context and reasoning behind the material they have to work with to answer the question posed – or when applied to industry: to make recommendations to a client for the most effective solution based on the information at hand. "Students need the technical or computer-based know-how to "wrangle" with real data sets; not just statistical models," he explains. He therefore made use of laboratory sessions with online DataCamp support. "This is an online platform that students can utilise to learn the data skills they need at their own pace, from non-coding essentials to data science and machine learning." This was particularly useful for students who wished to acquire more advanced programming skills.

Students had to change their mindsets from knowing the "right answers" and only being interested in passing the module to reaching the point where they could navigate the uncertainty of data- and evidence-based decision making on their own. "They had to learn to find the necessary tools to tell compelling stories to support business decision making."

According to Prof Joubert, real data is not tidy, and does not come in well-edited and curated Excel spreadsheets. "Yet, we expect our students to help businesses find answers to real problems when the data resides in a variety of sources, which often require some form of gathering, cleaning, fusion and argumentation." He remarked that if students were going to wait until someone gave them nice clean data, they might have to wait a long time: probably beyond the deadline by which the company has to make a decision.

To prepare his students for the world of work, he therefore identified and acquired real data sets that would allow them to make industry-relevant decisions that are aligned with their future prospects: from SAP inventory and sales data, to national census data and field test data of the Department's own optimisation of transport and logistics systems research. In this way, students could make inferences from real-world scenarios.

After implementing this approach, Prof Joubert came to realise that one should not try to cater for all students. "Each student is different and is motivated differently. We need to cater for both scientists and engineers. We need to teach them to navigate uncertainty, and to take ownership of the choices they make."

DR HELEN INGLIS
MECHANICAL AND AERONAUTICAL ENGINEERING

DEVELOPING PROBLEM-SOLVING SKILLS THROUGH EFFECTIVE TEACHING METHODS

Dr Helen Inglis, a senior lecturer in the Department of Mechanical and Aeronautical Engineering, has developed an effective approach to teaching that combines a focus on respect for students with a developmental approach to higher-level engineering problem solving.

A critical outcome of the third-year Structural Mechanics module that she teaches is that students should develop their problem-solving skills, transitioning from novice to expert. Her development of this attribute in students is based on three elements that form the essence of her teaching philosophy: the constructive alignment of the course content with the course objectives, the scaffolding of learning, and creating a productive classroom climate that is characterised by mutual respect. She maintained this approach to teaching in her online presentation of classes.

"When it comes to problem-solving as a graduate attribute," explains Dr Inglis, "a learning outcome in Structural Mechanics is that the student must solve unfamiliar problems." According to educational research, developing a new skill such as problem solving needs to be coupled with scaffolding, where the instructor provides supports to allow students to learn to do new things and then gradually removes these supports as they become unnecessary. "By creating scaffolded course content and assessment structures, students are able to refine their ability to solve complex engineering problems independently."

She applies these elements in her teaching by designing class examples and homework memos in a way that illustrates how to implement a problem-solving approach. In addition to highlighting key concepts in each homework assignment, she has prepared several additional videos and resources for frequently misunderstood concepts.

By implementing a hierarchy of assessments that increase in difficulty level as the students master certain essential concepts, she enables students to grow in confidence, which reflects positively in their performance. "Each lecture has an associated brief quiz, which includes an open-ended question that encourages students to reflect on their learning. The homework assignments are then designed in a way that allows students to apply the theory that has been covered in class, and to help them identify areas where they are confused or unclear." She continued to follow this approach during online teaching, presenting her classes as an online version of "chalkboard teaching".

Dr Inglis has observed that optimal learning is only achieved in the presence of mutual respect. "I therefore endeavour to establish a respectful climate in my classroom, even online, where students feel safe making mistakes while learning without the fear of being shamed." She encourages active engagement, while imparting a sense of shared purpose, acknowledging that students are individuals with their own complex requirements and circumstances.

KYLE OERDER
ENGAGE

PRACTICE MAKES PERFECT

Kyle Oerder is a lecturer in the Additional Physics module for first-year engineering students in the Engineering Augmented Degree Programme (ENGAGE). As the students who enter University from high schools across the country arrive in his classroom with a varied mastery of the Physics concepts necessary for engineering study, his challenge is to get all his students on the same level of understanding, so that they can start to grasp new content.

ENGAGE is the Faculty's 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 decreased gradually over a period of three years. It is mainly chosen by students who face challenges related to an inadequate background 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.

During the online delivery of the programme, Oerder made use of the flipped classroom approach, where students complete pre-class activities at home and work on live problem-solving tasks during class time. This approach was in contrast to the traditional style of content delivery, and had a more problem-oriented emphasis. "I made use of a social-constructivist approach to learning," said Oerder. This approach focuses on developing knowledge through interaction with others.

"As the students taking this module had varied abilities, the challenge was to keep the more advanced students engaged, while ensuring that those who were at an academic disadvantage were able to acquire the required knowledge." He therefore focused a lot of his time on practicing the concepts that the students were required to understand.

His lectures took the form of facilitated groupwork, where the students worked through typical examination questions. Group discussions during class were focused on how to solve various problems. He found this to be a successful approach, as it introduced students to alternative methods that could be used. "In this way, I could also see how the students were approaching a particular problem, and could address any methodological errors before they entered a test or examination scenario."

The online methods that Oerder adopted in his tuition worked well. He used a mixture of WhatsApp groups, Blackboard Collaborate's real-time video conferencing function and breakout groups. "This enabled me to adopt a hands-on approach, as Physics needs to be taught in action." He plans to continue making use of the group discussions when the students return to face-to-face learning as this teaching style resulted in good student participation.

PROF KARINA LANDMAN
TOWN AND REGIONAL PLANNING

LEARNING THROUGH REAL-LIFE EXPERIENCE

Prof Karina Landman is an Associate Professor in the Department of Town and Regional Planning, who teaches students at various academic levels. Among other topics relevant to the urban planner of the 21st century, the courses she teaches focus on sustainable planning and design, urban interventions and spatial concepts.

She strongly believes in finding a balance between the incorporation of knowledge systems from the Global North and the Global South. In her classes, she finds herself emphasising two elements in particular: repetition and real-life experience. "I believe that focusing on real-life experience is essential when teaching urban planning," she says. She does this by using case studies in her classes to illustrate real-life practices and exercises to simulate actual challenges experienced by urban planners in practice. This has the advantage of contextualising the work in the African and South African context, which assists with curriculum transformation.

In 2021, her final-year Urban Interventions (TPI 451) students worked on a real-life project in collaboration with the City of Tshwane, in which the Municipality served as the students' actual "client". For this project, the students had to develop a precinct plan for two former marginalised areas in the north of the City of Tshwane, Ga-Rankua and Hammanskraal/Temba. The Municipality's Planning Department provided the areas for the precinct plan, along with the information the students would require, and the project brief.

Despite the restrictions posed by the COVID-19 regulations, students could continue with this project by uploading their planning documents electronically. They received detailed rubrics to guide their planning in the absence of the traditional face-to-face tuition during studio sessions. Use was made of the Zoom platform to provide students with feedback on their plans. "What was particularly useful for the students was for them to see the lecturer physically drawing on their plans to make recommendations, as would happen in a physical practical session," remarked Prof Landman. An additional intervention that was implemented was the use of Sketchup software, a program that enabled the students to design 3D precinct plans.

A benefit of this approach of learning through real-life experience is that students experience what it is like working for an actual client, such as a municipality. "It prepares them for what to expect when they start working as a town and regional planner, which includes tasks such as analysis, conceptualisation, precinct planning and development control, as well as delivering a presentation to a client for approval."

The Municipality's planning official was a member of the panel that assessed the students' presentation of their precinct plans. The Department subsequently received very good feedback from the Municipality on the quality of the students' work in general.

TEACHING URBAN CITIZENSHIP

Dr Carin Combrinck is a senior lecturer in the Department of Architecture and Director of the University's Unit for Urban Citizenship. She was the joint winner of the Faculty's Teaching and Learning Award for 2022. Dr Combrinck is responsible for several courses in the Department that collectively contribute to developing a sense of urban citizenship.

She teaches from a position of conviction. "I believe that our societal transformation relies on the development of thought leaders through an engaged and a transformative education." Over more than a decade of teaching, she has sought to embed critical thinking in her students with the aim of transforming the architectural profession to be more responsive to South Africa's socio-spatial legacies of segregation and injustice. Her teaching methods synthesise philosophies of cognitive transfer, reflection and transformation according to the appropriate levels of moral and ethical development in the different year groups, resulting in a scaffolded approach in which epistemic shifts may occur.

By including the academic programmes she teaches in the activities of the Unit for Urban Citizenship, she is able to embed a culture of participation in graduates to achieve deep-seated, knowledge-based transformation.

The Unit for Urban Citizenship offers a platform for vertical integration between study years to integrate a socially responsive teaching and learning philosophy into the Department's programmes. It also aims to establish an interdisciplinary network of collaboration that can achieve the horizontal integration of its objectives with specific stakeholders through inter-faculty engagement. "By facilitating collaboration with our internal and external stakeholders, our teaching and research can be aligned to improved impact."

Dr Combrinck identifies any uncertainty students may experience during her weekly classes so that she can address any issues that come up timeously. "I encourage students to question the process and outcomes, so that they can take ownership of their decision-making processes." Seminars, studio time and online tutorials are arranged according to the overall class schedule, but are adapted when the need arises, depending on the students' workload.

In her teaching, she makes use of seminars, embedded community engagement, collaborative groupwork and peer evaluation, along with regular reflection and facilitated discussion. Her students are encouraged to engage with the requisite theory and prescribed reading in her classes, as this forms an integral part of their engagement in the field.

It also enables them to assimilate what they have learnt into their creative output. "In the third-year Citizen Design course, for example, students are expected to co-evaluate the work of their peers based on their own understanding of the literature." This encourages students to take responsibility for their own learning through what is known as "reflection-in-action".

In her Urban Citizenship Honours Studios, students review the exam rubric according to their processes and weighting. "In this way, an increased level of accountability is encouraged." Transparency in the reviewing process assists students to manage their expectations and offers them the opportunity to impact on the parameters and criteria of evaluation.

Themes and community networks that are identified in the honours programme are taken further in the Urban Citizenship Master Studios. Over the years, the participatory approach that is encouraged in the architecture studios and the meaningful engagement with key stakeholders have formed part of the Mamelodi Community of Learning Collaborative, which has opened up post-secondary school opportunities for the residents of Mamelodi through the reciprocal exchange of ideas.

Despite the fact that many of the spatial design challenges that the University of Pretoria's architecture students need to address in their practical projects are typical of a developing-world context, some parallels have surprisingly been identified in the development of low-cost urban housing in the Global North. This led to collaboration between the architecture departments of the University of Pretoria and the Chalmers University of Technology in Sweden, which has been ongoing since 2018.

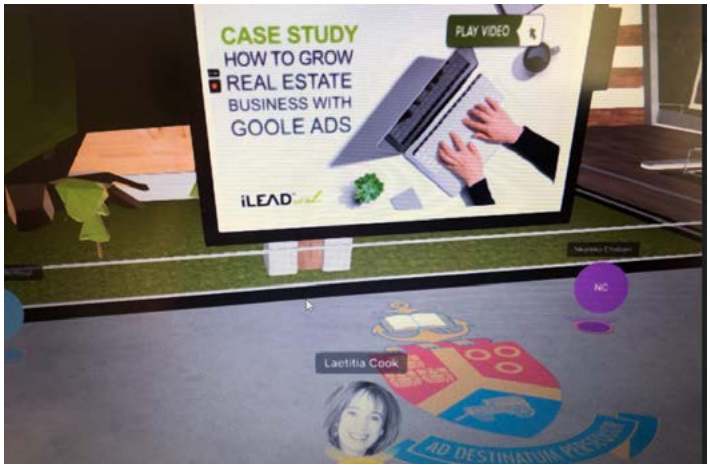
"This relationship provided the opportunity to engage a cohort of master's students, who had participated in my other courses, in the fully online Chalmers' Reality Studio in 2021." This studio is based on the concept of hyperlocal engagement and global knowledge exchange, relying on the synergy between the University of Pretoria's Urban Citizenship Studio, and Chalmers' Social Inclusion and Reality studios.

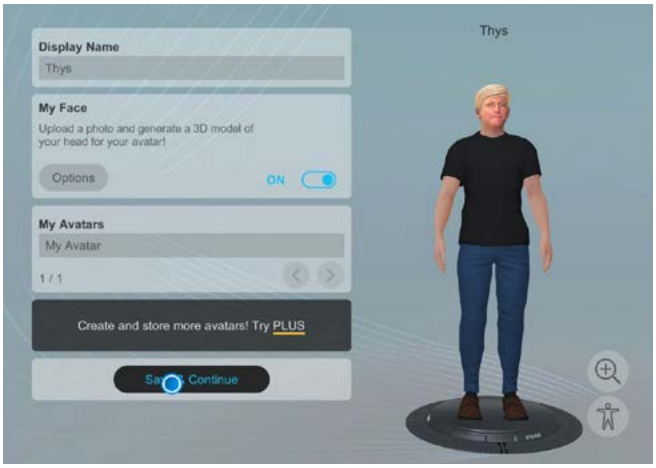
Dr Combrinck's research interests consider the role that the profession should play in the urban challenges that are faced in our country, as well as how to position our educational processes to prepare architectural graduates for this challenge. "I value the integration of research and pedagogy with intentional and impactful community engagement," she remarked.

She believes that spatial design plays an integral role in community development, especially when an interdisciplinary view is taken towards social innovation and urban citizenship. In the process, the role of a university, as an anchor institution and social actor, is embedded in the community, and is promoted and supported through a scholarship of engagement.

DR CARIN COMBRINCK
ARCHITECTURE

LAETITIA COOK
CONSTRUCTION ECONOMICS





EXPLORING THE METAVERSE

Laetitia Cook, a lecturer in the Department of Construction Economics, found that her students really missed the personal contact they had typically experienced in the classroom after teaching had to be taken online during the COVID-19 lockdown periods. Despite her best efforts, she found students' participation in class deteriorating and the sense of intimacy and cohesion that usually characterised her classes to be lacking. That was until she discovered the metaverse!

Presenting her modules to students in Quantity Surveying, Construction Management and Real Estate via Blackboard Collaborate, she found that even students who had initially participated via the chat box or microphone function became increasingly less enthusiastic to volunteer their opinions as the module progressed. This differed distinctly from her in-person lectures on campus, where she generally experienced good participation from the class.

She investigated some of the reasons for this lack of enthusiasm, and found that some students were just shy, and didn't enjoy speaking in front of classmates in an online environment, while others feared they would be perceived as trying to ingratiate themselves. At the same time, she observed that those same students liked to participate in virtual reality gaming sessions. This gave way to the idea of a virtual reality class, in the metaverse. In the realm of virtual reality, the metaverse comprises several virtual spaces in which users can interact with other users in a computer-generated environment.

As property investment is an element of construction management, her interest in the metaverse was sparked when she observed the trend of property being bought and sold in the metaverse. "I was fascinated by a media report of a patch of virtual real estate being sold for $2.4 million worth of cryptocurrency. This online environment (known as the metaverse) is a place where users can buy land, visit buildings, walk around and meet people as avatars," she explains. "Such environments grew in popularity as the pandemic caused people to spend more time online."

On a WhatsApp group she started with her students, she asked the question: "Is this a new asset class?" Together with her students, they started sharing articles on the metaverse with each other, and the investigation began in earnest. This led her to wonder whether holding a class in the metaverse might be more participative than on a conventional online platform. As the metaverse included numerous experiences, ranging from virtual gaming to a sports lounge, Cook wondered why it couldn't include a lecture hall. She therefore invited her students to attend a non-compulsory lecture in the metaverse.

The response was overwhelming. What made it so accommodating was the fact that students did not require any special equipment – they could log in using their laptop or desktop computers. The class that she presented in the metaverse was repeated on Blackboard Collaborate during the scheduled time, so students who were unable or hesitant to attend did not miss out on the course content.

"I was fortunate to have been granted a few hours in the metaverse free of charge, and the students loved it. For the first time, they were interacting with their classmates in the same spontaneous manner as they would have done in a physical classroom situation." Although it was still an online environment, the students experienced this virtual world on the same level as the "real world". "It is a completely intuitive platform, which is not difficult to navigate, and leads to the students being much more willing to participate. No special technology is required, and it is very versatile."

Although attendance of the metaverse lecture required more data than a Blackboard Collaborate lecture, the cost of data is declining. To purchase space in a well-known metaverse such as Decentraland or Sandbox is costly, yet metaverse space in general is much more affordable or even free to use. Unfortunately, the free platforms or ecosystems do not have the full functionality required for lecturing. She is thus investigating the potential purchase of metaverse space especially for lecturing. The costs are not prohibitive.

It presented a wonderful opportunity to expose students to the potential that the future holds – for education as well as real estate.

PROF STEFAN GRUNER
COMPUTER SCIENCE

TREATING STUDENTS AS RESPONSIBLE CITIZENS

Stefan Gruner is an associate professor in the Department of Computer Science. His teaching approach is grounded in his interest in philosophy, particularly the philosophy of science, and the philosophy of software technics and technology.

In introducing first-year students to computer science and operating systems, as well as teaching compiler construction to third-year students, and formal aspects of computing to honours' students, he believes that students should be treated as free, adult, self-responsible citizens of the Republic of South Africa. "In this way, I can identify the best scholars as future academics in computer science, who will carry the torch of science after I have left this earthly existence," he explains.

"In general, I try to work as best as I can against the internationally rising trend of the "schoolification" of tertiary education, where students are typically subjected to too many non-optional course modules, and where they are frequently over-assessed with far too many compulsory tests and assignments."

His idea of higher education is strongly influenced by the concepts of a Von Humboldt-type of university, as expressed by various philosophers of the late 19th and 20th century. This is based on the educational ideal of the German philosopher Alexander von Humboldt. This ideal developed around two central concepts of public education: the concept of the autonomous individual and the concept of world citizenship. Von Humboldt believed that a university should be a place where autonomous individuals and world citizens are produced or, more specifically, where they produce themselves.

Prof Gruner's strongest emphasis when he is assessing students is on solving problems with an open book. "A student who, despite repeated attempts, cannot solve problems with an open book in Computer Science has most likely made the wrong study choice, because Computer Science is, in the end, a problem-solving science," he explains.

"Beheld from a personal perspective, it takes some courage to honestly tell such a painful truth to a failing student, because – as human beings – we all want to avoid suffering." He therefore believes that it is important for a good professor to be able to provide students with encouraging hints towards other possible valuable life paths if a student's current path is only leading to a dead end.

PROF MACHDEL MATTHEE
INFORMATICS

SCAFFOLDED CONNECTIVISM TO PREPARE STUDENTS FOR THE FUTURE

Machdel Matthee, an associate professor in the Department of Informatics, focused the teaching approach she used in the second-year Information Systems programming module on encouraging autonomy and self-management in learners, guided connectivism to prepare programming students for future work, and accessing a diversity of resources on the internet. This approach is closely aligned with the principles of connectivism.

Prof Matthee explains that the central premise of connectivism is that knowledge resides in networks of human and non-human nodes, and that learning takes place by drawing on and being part of these networks. The connectivist approach to teaching and learning also reflects how professional programmers learn and interact. "I therefore believe it to be an appropriate strategy to prepare Information Systems programming students for their future careers."

She has, however, found that connectivism, as a pedagogy, does not pay enough attention to the limitations of the human working memory, which underlies cognitive load theory. "Connectivism says much about connecting to knowledge networks, but little about constructing new knowledge." This limitation necessitates the supplementation of connectivism with the proper scaffolding of challenging and new learning material.

Scaffolding refers to the well-planned exposure of students to increasingly more complex material until they have the skills to master the material on their own. "We assume that students can only choose from the vast sea of information and make meaningful connections if they have at least some existing mental schemas to inform their choices." Although students already have access to recorded and live lectures and comprehensive and challenging homework assignments, this was proven insufficient within the current approach.

Within the context of Information Systems, Prof Matthee believes that students' learning and programming self-confidence will improve if they are provided with access to worked examples and a pathway of exercises that have been compiled from existing resources. "This approach equips them with foundational knowledge and a road map to better navigate and choose from the vast number of internet resources available."

The effectiveness of this approach is centred in the fact that it gives students insight into the way a professional programmer will work once they enter industry. By already making use of practices such as trouble shooting and looking at other programs to see what will work best, graduates are entering industry with the vital computational thinking skills that are needed to succeed in the Fourth Industrial Revolution.

DAVE KA
INFORMATION SCIENCE

A STUDENT-CENTRED APPROACH TO HUMAN-COMPUTER INTERACTION

Dave Ka is a lecturer in the Multimedia programme in the Department of Information Science. His interests lie in human-computer interaction (HCI), user experience and the investigation of object selection and interaction within virtual reality. As technology forms an important part of the subject content, he sought a way to keep his students engaged during online classes by incorporating technology into the formal learning space.

The third-year module that he teaches is focused on the theory behind HCI. It is concerned with the usability of information technology (IT)-related products. It emphasises design in a way that empowers users in their everyday lives. Ka encourages multimedia designers to approach design from the perspective of the user, a mindset that is inherent to the field of HCI. "My teaching style is shaped by the philosophy of treating my students as users of the module content, thus approaching teaching from a student-centred perspective," he explains. This means that the goal of teaching is not to tell students what they do not know, but to facilitate the learning process to enable the students to become independent learners. "This results in them being able to apply their knowledge more effectively in a real-world situation."

He adopted the flipped classroom approach to teaching at the start of the nationwide lockdown in 2020, which involves moving traditional passive teaching activities outside the classroom and using class time for active learning. By providing the module content in the form of pre-recorded lectures, he could use the class time to engage students in solving hypothetical problem scenarios that were related to real-world applications. With this approach, he found the students to be much more interactive in class, and to show a more robust understanding of the content.

The hypothetic scenarios that formed the problem-solving class activities took their inspiration from mobile apps that could be used to help users carry out their daily tasks, such as finance and budget management, health and fitness tracking, language translation and interpretation, grocery list management and insurance management. "By presenting students with real-world problems, they were able to see the relevance of the learning material."

He furthermore made use of Google Workspace's online collaborative products, to which all students had access. This allowed the students to work together on activities during class. By giving them the opportunity to learn in a collaborative workspace, they could learn from each other and benefit from each other's mistakes in a low-risk environment. The platform's text chat function also encouraged students to respond in class. "This gave me the opportunity to engage with students who do not usually participate in a traditional classroom situation," he explains.

This intervention was adopted with minimal effort when hybrid classes were presented in 2022 because students were already using their electronic devices to attend class, whether they were attending in person or online. This intervention will be continued when physical classes resume, as it encourages students to participate in class activities, which contributes to experiential learning.

TEACHING FOR THE FUTURE OF WORK

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