



Innovations in Pharmacy Education during the Pandemic:

Using Learning Science to support laboratory-based practical skills

J McCartney, S Egieyeh, N Ebrahim, E Braaf, D Beukes

School of Pharmacy, University of the Western Cape

South Africa's higher education sector rapidly switched from campus-based teaching to online asynchronous teaching in April 2020. This sudden change imposed on universities saw pharmacy academics rushing to master new skills, re-invent laboratory-based practicals and assignments, develop online asynchronous teaching resources and explore various digital techniques that could be utilised during South Africa's lockdown period, which extended over far more months than the initial few weeks that were implemented.

Hands-on laboratory experience was not possible until lockdown restrictions were eventually relaxed towards the end of 2020, allowing restricted access of limited numbers of students into the laboratories, for shorter periods of time.

A partnership established in 2019 between the University of the Western Cape (UWC) and Learning Science UK allowed UWC to rapidly implement and extend the Learning Science laboratory simulation programme (LabSims) across the Faculty of Natural Sciences. As expressed by Professor Mike Davies-Coleman, Dean of the UWC's Faculty of Natural Sciences, "Since we can't bring students into the labs because of the pandemic, we've been bringing the labs to them online, allowing them to immerse themselves in a user friendly interactive space, learn the relevant skills and feed that back into their future experiments."

Learning Science UK is used in nearly all of the top universities in the United Kingdom and has expanded to universities across Europe and in Australia, New Zealand and the United States. In 2020, UWC became the first university in Africa to use Learning Science UK online. With the forced closure of undergraduate laboratories at the start of the lockdown in 2020, UWC's Centre for Innovative Education and Communication Technologies (CIECT) assisted lecturers with the integration of LabSims into their teaching modules, accessed via iKamva (UWC's Learning Management System).

The integration was so successful that within the first three months of implementation, UWC set a Learning Science record

with over 3 500 activities undertaken. This was the single largest engagement across Learning Science's interactive programmes by any university in the world and resulted in UWC's CIECT being awarded the International 2020 Learning Science Teaching Innovation Award for its extremely effective roll-out of the Learning Science laboratory simulation programmes in the Faculty of Natural Sciences.

The LabSims and associated Smart Worksheets allowed pharmacy students to develop and practice key competencies across the science-based disciplines such as Biology, Chemistry, Pharmaceuticals, Pharmaceutical Chemistry and Pharmacology.

Prof. Denzil Beukes, Deputy Director of Pharmaceutical Sciences, first introduced LabSims to BPharm 2 students a few weeks before the lockdown in 2020 as part of their pre-practical preparation for Pharmaceutical Analysis. He continued to use LabSims with the second-year students in April 2021, saying, "Remember, these students (who completed first-year in 2020) barely got into our laboratories and would have completed LabSims for their chemistry practicals when in their first year of the BPharm programme".

The pre-lab preparatory work completed online with LabSims, together with a pre-practical online assessment, ensured that



LabSims Preparing for your chemistry practical
(Source: <https://learningscience.co.uk/>)

students came into this year's practicals feeling more prepared. *"It was interesting to see how relaxed the students were in this year's lab-based practicals, because they obviously felt familiar with the equipment to be used, having completed the online simulations. The stress levels seemed to be lower and students' questions showed us that the students were now focusing on the concepts that they needed to learn, rather than how to use a piece of equipment correctly. Students were comparing and interpreting results with each other rather than showing a friend how to use the equipment in order to do the experimental work. It has been rewarding to see a more academic level of social interaction in the practicals leading to effective peer-learning."*

Two main themes emerged from student feedback. Firstly, students felt more comfortable with the use of equipment and techniques used in the practicals, and secondly, they appreciated the immediate feedback they obtained from the interactive simulations. They could repeat any activity, multiple times, until they were confident.

Second-year BPharm students were also able to use LabSims to complete simulated isolated organ experiments which are designed to enhance understanding of basic pharmacological principles of drug-receptor interactions. The inclusion of the Smart Worksheets after completion of the online practical allowed students to generate experimental data online and interpret data with real-time feedback, allowing interactive and continual learning, at the individual student's pace. Dr Jane McCartney explained, *"This was my first experience with the LabSims programme and I found the simulated practicals to be interactive, user friendly and visually interesting. In addition, feedback from the 2nd-year students was positive, with nearly 80% of students indicating that the practicals were helpful in enhancing their understanding of the concepts. The interactive Smart Worksheets were also useful in assessing understanding of the key concepts and practising calculation skills."*

Dr Samuel Egieyeh's final year module, Pharmaceutical Biotechnology (PHA426), focuses on this relatively novel and rapidly advancing field in which the principles of biotechnology

are applied for the development, manufacturing and quality assurance of biologics, gene therapy as well as pharmacogenomics. This topic is becoming increasingly important for the next generation of pharmacists because the majority of therapeutic drugs entering the current market are biologics, such as antibodies, protein products, nucleic acid products and vaccines. Dr Egieyeh explains *"I have struggled to teach this module for the three years prior to 2020. This is because each year, I had to "re-teach" the basic concepts of biotechnology and molecular biology, which the students learned in their first year and have obviously forgotten. Only then can I move on to the advanced concepts in the module (all within the limited time allocated for the module). The advent of the Learning Science platform provided a better way to approach the teaching of this module and eased the students into the module content. The Learning Science animations were embedded in the PHA426 iKamva site, allowing students to revise the required basic pre-requisite knowledge. Subsequent completion of a quiz showed me that the majority of the students now had the knowledge required to engage with the module content. This made my teaching a lot easier in 2020 as the students now had a better understanding of practical concepts that they needed to apply to the new pharmaceutical space of biologics. This improved understanding was evident in the unprecedented 98% pass rate in the final exam"*.

Overall, the Learning Science platform, with its interactive animations, provided the students with a basic understanding of the central dogma of molecular biology and provided the link between the basic biotechnology experiments and the complex production process, formulation, and quality control of biologics that was taught in this module.

In Pharmaceutics, Dr Naushaad Ebrahim implemented the Learning Science Lab simulations with third- and fourth-year pharmacy students. *"For the third-year students, we started with basic laboratory induction videos / interactive animated simulations covering topics such as dress code, laboratory safety features and an introduction to basic lab equipment, e.g., the Bunsen burner and the microscope. This was followed by simulations relating to the module content, i.e., microbiology simulations ranging from various inoculating techniques to microbial staining"*. Lab assessments were based on aspects of the simulations and tested student understanding of the simulations completed during each practical.

The Learning Science simulations were also incorporated in the Pharmaceutics elective module (Advances in Pharmaceutical Sciences) as part of the online course presented to final-year BPharm students.

The Learning Science platform offers conventional illustrative videos as well as interactive animations. Dr Ebrahim added *"The latter is where we feel the students benefit the most as these simulations not only provide information regarding steps and sequencing of equipment operation but also provides information if an incorrect selection is made. Students are also able to take their time to familiarise themselves with equipment and techniques as opposed to an actual lab setting with limited time and in some cases resources."*



Smart Worksheet completed and assessed

Student feedback to the Learning Science platform simulations has been positive and well received. During the weekly online discussion forums, one student commented, *"I found the simulations very easy to follow and it explained well"*, while another student added *"I found the simulations very easy to understand and complete."*

The Learning Science simulations will now be further integrated as a tool for content presentation in 2021 and will definitely play a key role in the presentation of laboratory-based practicals post COVID-19 lockdown. One lesson learnt from 2020 is that we can do things differently and still achieve.

Acknowledgements

Learning Science <https://learningscience.co.uk/>

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Image 2: Smart Worksheet completed and assessed (Source: <https://learningscience.co.uk/>)