KAREN FOLEY: Welcome back to the STEM showcase. Well, haven't we had a packed day, learning about new things? This is the last of our sessions, but we're going to focus on practical skills that you can learn through the OpenSTEM labs. We've heard about these through various sorts of discussions today.

But I'm now joined by Helen Lockett, who is the director of the OpenSTEM labs, which are the Open University's remote and online laboratories. And Helen is also a senior lecturer in engineering.

So big, warm welcome, Helen. You're here to talk about what the OpenSTEM labs are, so maybe you could begin by explaining, for students who are not familiar with them, exactly what they consist of.

HELEN LOCKETT: So hi, Karen. It's great to be here. So the OpenSTEM labs-- they're the way that we deliver remote and virtual laboratories to our STEM students. So students can connect from home to undertake practical learning very much in the way they would in a face-to-face lab. But if you want to think of it in simple terms, you could say, well, we're bringing the laboratory to the student's home.

KAREN FOLEY: Brilliant. And there are lots and lots of different things. We're not going to have time to talk about them all today, but we did want to focus specifically on the OpenSTEM labs and engineering students, perhaps because this is your speciality area. So can you tell us about why they're so important for our engineering students?

HELEN LOCKETT: So, of course, engineering is a very practical subject, so the students really need to get that practical learning alongside all of the theory. And our engineering courses are accredited by professional engineering institutions, so it's really important that we meet those practical engineering standards the same as every other university in the UK.

We deliver our practical learning in a variety of ways. We do residential schools. So, in usual years, students would go and spend one week intensively at level 1 and level 2 learning practical engineering. And then we also use the OpenEngineering Laboratory, which is the engineering wing of the OpenSTEM labs, to do remote practical experimentation.

And maybe it's worth me just saying, the boxes behind me-- we're running our practical engineering home experiment module at the moment. So those are my boxes that were delivered to me about a month ago, and that's my beginnings of attempts of doing what the students are doing at the moment for their home experiment kits. And I'll be tutoring that in a couple of weeks' time.

KAREN FOLEY: Brilliant. Nick was telling us earlier about how, with COVID, we'd had to make so many rapid changes. And actually, making these kits-- I think colleagues were literally trying to get stuff together and get them out to the students so that they could still enjoy something. How wonderful is that? Are you winning with it?

HELEN LOCKETT: We are. The module team did a fantastic job. They've had to write an entire new module in six months, and then the technical staff have done a brilliant job packing up, I think, 1,800 kits and sending them out to level 1 and level 2 students. So it's been a really huge task, and we're right in the middle of delivering it now.

KAREN FOLEY: Brilliant. And one of the things that I really like is that, while the OpenSTEM labs are so complex, you start students off at a very simplified level, I guess, where they're starting to build up with simple activities, observing experiments, and eventually, then, which we'll learn about a little bit later, being able to control some of those experiments themselves.

HELEN LOCKETT: Yep, that's it. So at level 1, we just try to get the students getting used to observing the experiments, but not necessarily controlling things for themselves. And those activities can work brilliantly. If you think of a conventional university, students which go into a lab, maybe have a one- or two-hour session, and undertake an activity there and then. But some activities might work better over a longer period of time.

So maybe I'll give you one example. At level 1, students undertake a creep experiment. So people might not know the term creep, but if you think about-- maybe if you put a coat hanger with a heavy coat on it in the wardrobe. You left it for six months, and over those six months, it'll gradually droop down so that when you took the coat off, the coat hanger's deformed. So that kind of slow deformation is called creep.

So we set up a creep experiment in one of our research labs with a metal bar, and we've got a little video we're going to show. So we have a metal bar, and we put an extension onto it in a heated environment. And that experiment runs for something like a week, and the students can drop in at any time during that week.

And if you watch the video on the screen-- I'm going to run it again in a minute, but hopefully you saw. The metal bar very, very slowly extends. I think you're watching about 15 hours of the experiment compressed into 12 seconds, and nothing happens for a while. But if you look near the top, it makes what they call a neck-- just gets a bit narrower, and then the narrow part breaks. And that's obviously the place where the highest stress causes the failure.

So what's quite interesting about this experiment is that each student takes a number of measurements, but the measurements from one student-- they're not really enough to fully understand the behaviour of that material. But because we have hundreds of students on the module, they can all be collecting data at the same time. They'll all take a different time periods through the week, and that data set, together, gives them a much better representation.

So it's quite interesting, that one, because it's a real example of an experiment that maybe works better remotely than it would in a face-to-face lab.

KAREN FOLEY: Because, with having so many students, you can get a really robust data source if everyone looks at it. But I'd want to look at the bit where it breaks, because that seems the most exciting bit, I think.

[LAUGHTER]

HELEN LOCKETT: It was funny. We didn't expect, but the first year they ran it, what they found was that our students started to see the extension going up. There was a mad rush of people trying to be there just at the moment where it failed.

[LAUGHTER]

KAREN FOLEY: Brilliant. Oh, that's amazing.

Emily says that OpenSTEM labs are amazing. She did the online summer chemistry school last year. She said getting to do spectroscopy and HPLC investigations was fantastic. So big thumbs-up from Emily there.

HELEN LOCKETT: Great.

KAREN FOLEY: So we've seen some of these sorts of aspects here, in terms of the time lapse, but how do students then build up skills with engineering, because it's very practical, as you said earlier, in terms of the things that they need to do. So generating, I guess, some experience in the laboratory is important, but what else can you tell us about how students build their experiences through the qualification?

HELEN LOCKETT: So what you saw with the time lapse is students' learning about data collection, observing an experiment, collecting data. But as they go through, what they really need is about learning to control engineering equipment, maybe to investigate different parameters, see the effect of making changes, trying to solve a problem, an engineering problem.

So at level 2, we start to build in activities where students are doing remote experimentation from home, and that means that we'll have to have multiple sets of equipment that are set up on our racks so that, maybe, we might get 500 students through an activity over two weeks. So we maybe have 20 sets of equipment.

And this time, the students have to book at a time that's suitable for them. But we offer them 22 hours a day, seven days a week. So people book ahead, they book a slot, and they have that equipment allocated to them for a whole hour where they can explore and learn how to use it. And if they find it difficult, they can book another slot and try again.

So maybe it's a good time to show you a little video, again, of an activity that students run. So this would be a second-level electronics activity. And the students are learning about signal processing. So this is the user interface the student sees, and the students have been allocated this particular piece of kit, and you can see the little video.

I hope you saw the disc started spinning. So as the disc spins, essentially, we've got some sensors at the top and a light source at the bottom. And there were slots in the disc, so, as the disc spins, we get a kind of wave where, when the sensor sees the light, we get a signal. When it can't see the light, we don't.

And the students are exploring the data processing rate, how many samples they take a second, and the total number of samples. So hopefully, you can see, here, the student can start up the disc at the speed they're interested in. They can choose how many samples they want to collect. And then, when they click on the Get Samples, we see a visualisation of the data.

And at the bottom, you can see that square wave. So data points with no signal, and then data points with signal.

And what the students are learning is that, with this quite low sample rate and not many samples, it's not that resolved, the data. And what they can do is explore by, for example, changing the sample rate. So a higher sample rate allows the students to get more samples per square wave. So hopefully, we'll see that in a minute so you can see a lot more points on the square wave. It's a bit more refined.

But the pink curve at the top is frequency domain, and we've still only got 32 samples, 32 data points. So next, the student might try, well, let's have a lot more data points. Maybe try and increase it to 1,000 data points this time. So when they put in the higher number of data points, we'll run it again. You can see, the disc is still spinning, so now we're going to take 1,000 points.

And now we get this nice, resolved frequency response at the top with the very clear peaks for the different frequencies. We've still got this nice, detailed square wave. And I won't show you more, but the students go on to do some analysis on that data.

I hope that gives just a flavour of the way a student would interact with the activity.

KAREN FOLEY: No, it absolutely does. And it also shows, I guess, the way in which students can control something-- specifically, themselves in that time slot, to be able to play around with something, and very importantly, for me, anyway, not break it. So that's the main thing.

But it's incredible that, in Milton Keynes, there are these buildings with all of these things going on that people can then access.

Let's take a quick trip to Nicola and see how everyone is doing back at home. And I know it's been a ram-packed day, Nicola, but we've been asking people about some of the things that they'd most like to experience in one of our widgets in our remote laboratory. What have people said, in terms of their responses to our widget? We'll take a look.

NICOLA: The majority of people are actually looking forward to exploring a virtual world, so it's 43%. And then, after that, using a scientific instrument. Joined at third is watching a live experiment and testing a hypothesis, and at the bottom is using the engineering equipment, unfortunately.

HELEN LOCKETT: Oh, the engineer in me is very disappointed.

[LAUGHTER]

NICOLA: Sorry about that, Helen.

HELEN LOCKETT: Not enough engineers on the line. If we look at exploring a virtual world, that is something that we do in the OpenSTEM lab. So we have activities, a virtual ocean's activity. We could go under the ocean and a virtual geology field trip. So there are lots of things that can be done there.

KAREN FOLEY: Brilliant, OK, excellent.

So what are some of the things, then, for those nonengineering students in the OpenSTEM labs? Can you tell us a little bit about what other things other students can do there?

HELEN LOCKETT: Yeah. So engineering is just one wing of the lab. We have activities, really, all across the STEM faculty. So in science, space, and physics, we have the OpenScience observatories.

So we're very lucky. We have observatories on the island of Tenerife. We put them there because it's great for observing, but the students can access them from home. You can see-- I think we're going to show you a little picture with a montage of a few activities.

So yes, so you can see the domes of our telescopes in Tenerife. And students connect to those and observe from the sky from home. You can also see on that montage, at the bottom, scanning electron microscopes. So they're research-grade instruments, and students can look at either biological samples, like the one we've got here, or geology samples, and really understand those in detail. It's something that a lot of undergraduates wouldn't get to do, controlling for themselves.

Also, one more example to pick up, maybe, is the Mars Rover in the bottom right. So students on S818 participate in an activity to control this rover to search for water on Mars.

So this is a little rover. It sits in a great, big sand bed in a shed on the campus. And over about a week, a team of students supported by their tutors will control that rover, control its use of power, and make decisions about how it should search, and it's searching for water on Mars. It's a really immersive activity that's built on our research expertise of working with people like ESA to do real space exploration.

KAREN FOLEY: Brilliant. It sounds awesome.

You're also doing stuff with engineering, in terms of aerodynamics and looking at airflow.

HELEN LOCKETT: That's right. So we've managed to keep almost all our OpenSTEM lab activities going during the lockdown due to COVID, and we've even developed some new activities.

So it's four wind tunnels they used on T229 module, mechanical engineering module. The students are controlling the wind tunnel. So we put in sections, little cars, or aerofoil sections of wings, and the students are looking at the drag and the flow over those vehicles, and they're understanding flow. And they can control the flow speed and the angle of attack, the angle that the vehicle is in the flow.

And it's been fantastic. We've run that for the first time this year, and it's gone really well.

KAREN FOLEY: Brilliant. It sounds awesome.

Well, we asked people at home what OpenSTEM lab experiments they would like to try for themselves, and this is what they said. The most thing that's interesting to them is the telescope and the Mars Rover, so they sound incredible to do. But also, the wind tunnel getting some interest, and the microscope and some signal processing.

I think-- did we have some images of what some of those might look like, Helen, in terms of how they might be experienced? I know we've seen some of the things like the telescope beforehand.

HELEN LOCKETT: Oh, yes, we do have one more picture. You're right. Call me out.

KAREN FOLEY: It's always nice to see. Here's what you could have won!

[LAUGHTER]

HELEN LOCKETT: So you can see there. Top right is quite nice. That's the wind tunnel. So we've got four of these wind tunnels, and when students run them, they have live video, and then they're controlling the actuation on there.

In the bottom, in the middle, you can see that's the virtual microscope. So this is from students studying cells, biological cells. And they can really explore and understand the structure of the biology that they're looking at. And then, as you said, we've seen the picture before, but we've got the telescopes and the Mars Rover.

KAREN FOLEY: Brilliant. Now, say some poor students don't have access to the OpenSTEM labs in their module. They can still get involved. So tell us what your favourite recommendation might be for students who don't have anything included in their qualification.

HELEN LOCKETT: Well, I think something really nice to try is the virtual microscope. And we have an external website called virtualmicroscope.org. So if you just go into the browser and search for virtual microscope, I think you'll find it. We put a picture up on the screen there.

So this is a fantastic resource. It's been built up over quite a long time, and it's got lots of collections for people to look at. And my favourite one in there is the Apollo moon rocks. So you can go and look at moon rocks that were collected from, I think, every Apollo mission and just go and study them, and what an amazing thing to be able to just look at moon rocks from your own home. I just think it's fantastic.

And it's completely free. Just connect and have a look.

KAREN FOLEY: Brilliant.

Well, Helen, thank you so much. That's been absolutely fascinating. A real insight into just some of the activities that students can get involved with.

But again, really lovely to see how they really build skills and develop confidence as students progress throughout their qualifications, doing a variety of different things, be it in engineering or not. So thank you so much for coming along today.

HELEN LOCKETT: Thank you. It's been great.

KAREN FOLEY: Great, brilliant.

Well, that is the end of our programme. And we've been overrunning ever so slightly. I know lots of people have meetings to go to, et cetera.

Before we go, Nicola, let me just check in and see how you and everyone are at home. We've covered so much material. I think we're all desperately in need of a nice cup of tea and a sit-down.

NICOLA: I think I would agree. I think everyone's getting tired now. It's been a long morning. Thank you, everyone.

KAREN FOLEY: Absolutely.

Well, thank you so much for managing our hot desk for us. We've also had Matt on the chat, and Heather, at various points today. And I know many other colleagues have dropped in and out.

I hope you've enjoyed the programme. Please do visit the Student Hub Live Website, where you can watch the catch-up, which will be available shortly. Plus, we have lots of other activities lined up for you.

If you're having a little bit of a break, we're going to be having a range of things for module start, so please do join us if you'd like to, for example, brush up on your essay planning or writing, or critical thinking, et cetera. We'll have lots of workshops. You can subscribe to our newsletter on the Student Hub Live website just by giving us your email, and then we'll notify you when we release new events that may be of interest to you.

So, for me, thank you so much for watching. I've really, really enjoyed today's content, and thank you so much to all of our wonderful contributors who've made this so special today. And thank you, at home, for sharing so much advice and inspiration and your thoughts with us today.

See you at another Student Hub Live event very soon, and enjoy the rest of the day. Bye for now.