

# LEARNING TO TEACH ONLINE



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CASE STUDY [www.ilabcentral.org](http://www.ilabcentral.org)

## iLabs: Online access to remote laboratories

Featuring: Dr Mark Schulz, The University of Queensland

### Context

- A free online resource for science students and teachers that enables remote access to specialised laboratory equipment and experiments

### Description

- iLabs is an online management system designed at MIT that enables expensive scientific equipment to be shared with the world 24 hours a day  
- The University of Queensland has used the iLabs architecture to make several pieces of their science and engineering equipment freely available  
- iLabCentral ([www.ilabcentral.org](http://www.ilabcentral.org)) is a website that contains creative commons licenced teacher support and student learning materials that uses the University of Queensland's equipment via iLabs

### Technology

- Websites, no special software required

Written by Simon McIntyre

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## Aims and overview

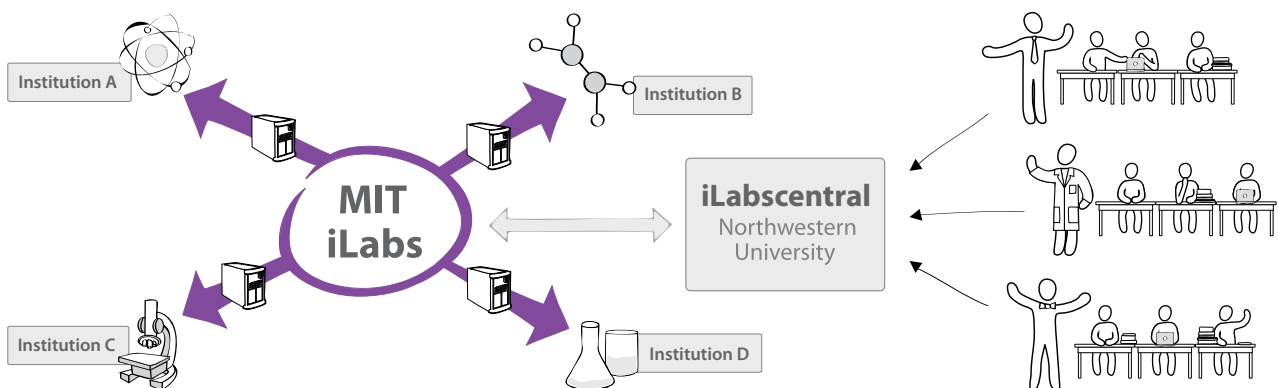
This case study examines the concept of using the Internet to remotely access laboratory equipment to conduct experiments in science or engineering. In particular, it demonstrates one of several experiments that can be conducted online using the [iLabCentral](#) website developed by [Northwestern University](#). It explores benefits and opportunities for student learning offered by iLabs, by demonstrating how online learning materials in the iLabCentral website utilise remotely access specialist laboratory equipment made available by the [Centre for Educational Innovation and Technology](#) (CEIT) at the University of Queensland, in Brisbane Australia.

## What is iLabs?

The [iLabs architecture](#) was developed at the Centre for Educational Computer Initiatives (CECI) at MIT, to enable real laboratory equipment to be accessed and operated remotely through the Internet. It removes physical and time restrictions of the laboratory, giving an almost limitless number of students and teachers all around the world the chance to use specialist equipment to conduct experiments in fields such as microelectronics, chemical, structural and electrical engineering, and signal processing.

Using this software, universities around the world can develop systems that enable remote access to their scientific equipment by other universities, schools and individuals, 24 hours a day, 7 days a week. The University of Queensland has done just that, using the iLabs architecture to make several pieces of equipment available online for their students, and other students and teachers around the world.

As well as allowing remote access to high-end scientific equipment and facilitating the transmission of data collected in remote laboratories, iLabs also enables institutions to develop their own online learning materials and experiments that can interface with the system. The website [iLabCentral](#) is one such example. Developed by Northwestern University, this website contains a range of creative commons based curriculum design and teacher support materials, as well as experiments and online learning activities that (via the iLabs system) integrate with a range of specialist laboratory equipment in institutions around the world.



*iLabs is a management infrastructure that links the systems that control lab equipment at different institutions together, enabling others to access this network. Software that controls the individual pieces of laboratory equipment is developed and run at each institution where the equipment is housed, and these, or other 3rd party institutions, may create and host online experiments and learning materials that utilise remote laboratory equipment through the iLabs network, such as iLabCentral.*

## Case study outcomes quick summary

### Key benefits

- Enables an almost unlimited amount of students and teachers the opportunity to conduct remote experiments using high-end scientific equipment they might otherwise never have the chance to use
- Enables institutions to share their specialist equipment with others all around the world, without the limitations of distance and restricted access time
- Improved engagement with students, many returned to work on online experiments to further their understanding after face-to-face tutorials were completed
- Students have the ability to access laboratory equipment outside of normal tutorial times, meaning that they can repeat experiments frequently and at any time that suits them to improve their understanding
- Students have time and freedom to experiment with, and explore the equipment, rather than having to rush to complete a certain experiment in a limited amount of time in class
- Experiments can be run autonomously, meaning users can access them 24 hours a day, 7 days a week
- Enables teachers and institutions to share expensive equipment and learning and teaching resources with other universities, schools and colleges
- Eliminates any occupational health and safety (OHS) issues with using hazardous or high risk equipment
- Designed to run in any browser and can be accessed easily with minimal Internet bandwidth

### Key issues to consider

- Some experiments are more suited to being conducted remotely online than others. For example experiments that depend upon consumable materials (such as those used in chemistry) require more maintenance
- Remote experiments are not designed to replace face-to-face laboratory experiments, but can be a useful addition to students' usual tutorials
- Teachers using remote experiments will be at the mercy of technical issues, and an uncertainty of when equipment may be changed or decommissioned

## Why did the University of Queensland join the iLabs network?

Dr Mark Schulz, Associate Director of the [Centre for Educational Innovation and Technology](#) (CEIT) at The University of Queensland, explained that his institution has worked with iLabs at MIT to share scientific equipment with the world that can facilitate experiments related to nuclear radiation, electrical engineering and physics. Enabling students to access such equipment was thought to be important because:

- There were only a certain number of pieces of equipment available in the university labs for a growing number of students
- Students only had access to equipment during the limited amount of class time, therefore time for students

*to successfully complete and understand experiments was severely limited*

- *As a result, students were having to conduct experiments before or after the appropriate point in the curriculum just to deal with the demand on the limited equipment*
- *A great deal of money was invested in physical laboratories, but they were not able to solve all of the above problems or to be used most effectively*
- *The university wished to assist other institutions and schools by enabling their students access to the University of Queensland equipment, but physically sharing the equipment was not a practical solution*

## Why iLabs?

CEIT chose to use the iLabs architecture as a way to enable the sharing of their laboratory equipment for the following reasons:

- *iLabs provides the management infrastructure enabling experiment data to be transferred to different clients, managing remote access to local devices and connecting equipment to a worldwide network*
- *Software that controls the different pieces of actual equipment is still developed and hosted on site, with iLabs architecture being the 'broker' that manages access from the outside world*
- *It has the ability to scale up access to specialist equipment beyond the usual class size to an almost limitless number of students and teachers*
- *The source code and documentation for iLabs architecture is [freely available for download](#), and MIT offers support and welcomes collaboration and sharing from other institutions*
- *The University of Queensland could become part of a larger worldwide network of institutions contributing to the improvement of science and engineering education globally*

## Planning

There are two levels of planning involved when developing online laboratories, technical and pedagogical. In other words, how can equipment be conducted remotely through the Internet, and what are the learning designs behind the experiments that utilise the equipment? Designing effective pedagogy for scientific experiments is beyond the scope of this case study, however Mark offered the following advice to consider when first thinking of developing an online laboratory experiment:

- *Is the experiment you want to make available already computerised or not? Computerised experiments are easier to develop for iLabs than those that are not, but in some cases experiments can be updated*
- *Experiments that intend to help students understand how to use equipment, rather than for collecting and interpreting data, must be approached differently when it comes to the pedagogical design*
- *Often the same equipment can be used for a wide range of different experimental scenarios across a range of disciplines. This is evident on the [iLabsCentral](#) website*

CEIT can help teachers and institutions with the technical and pedagogical aspects of developing an online experiment and making it globally available, and can be [contacted](#) for more information.

## Teaching

The [iLabsCentral](#) website was used in this case study as a good example of how an institution can develop pedagogy focused learning materials to support students remotely accessing laboratory equipment through the iLabs system, such as the equipment offered by The University of Queensland.

Technology is only an enabler for teaching, and does not ensure a good learning experience. The iLabCentral website is also a great source of creative commons licenced pedagogical guidance and support for teachers interested in using remote experiments in their own teaching practice. Once registered on the site, teachers can find a wide range of support materials including:

- *Ready made experiments using remotely accessed equipment for students in a range of grades, which include interactive learning activities and supporting resources*
- *A range of curricula supporting a wide range of experiments in biology, chemistry, maths and physics*
- *Comprehensive teacher guides that outline the pedagogy behind the experiments, the scientific background knowledge, learning goals, additional resources, etc*

## Conclusion

We hope this case study has provided you with a good explanation of the concept and potential of online laboratories, or 'iLabs', and has given you some ideas about how you could use iLabs in your own teaching. If you are considering this, we recommend that as a starting point you view the technical glossary video about the iLabCentral website that can be found on the Learning to Teach Online website.

## Additional information

iLabs at the Massachusetts Institute of Technology (MIT) <http://icampus.mit.edu/ilabs>

iLabsCentral from Northwestern University [www.ilabcentral.org](http://www.ilabcentral.org)

Centre for Educational Innovation & Technology, The University of Queensland [www.ceit.uq.edu.au/ilab](http://www.ceit.uq.edu.au/ilab)

## Additional reading\*

Harward, V. J., del Alamo, J. A., Choudhary, V. S., deLong, K., Hardison, J. L., Lerman, S. R., et al. (2004). [iLab: A Scalable Architecture for Sharing Online Experiments](#). Paper presented at the International Conference on Engineering Education ICEE, Gainesville USA.

Harward, V. J., del Alamo, J. A., Lerman, S. R., Bailey, P. H., Carpenter, J., DeLong, K., et al. (2008). [The iLab Shared Architecture: A Web Services Infrastructure to Build Communities of Internet Accessible Laboratories](#). Proceedings of the IEEE, 96(6), 931-950.

Or-Bach, R., Livingston Vale, K., del Alamo, J., & Lerman, S. (2006). [Towards a Collaboration Space for Higher Education Teachers - The Case of MIT iLab Project](#). Paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications 2006.

*\*Note: Some readings are held in subscription only databases. In most cases accessing the link from your institution's network will enable access.*

## Acknowledgements

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iLabcentral [www.ilabcentral.org](http://www.ilabcentral.org) was developed by [Northwestern University](#). The website and content appears in this case study in a non-commercial context under a Creative Commons Attribution-Noncommercial-Share Alike 3.0 United States License [www.creativecommons.org/licenses/by-nc-sa/3.0/us](http://www.creativecommons.org/licenses/by-nc-sa/3.0/us).

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**Dr Mark Shulz**

*Associate Director, Centre for Educational Innovation and Technology*

## For more Learning to Teach Online, visit the COFA Online Gateway



To find out more about the Learning to Teach Online project, or to view the video component of this episode, please visit the COFA Online Gateway.

[www.online.cofa.unsw.edu.au](http://www.online.cofa.unsw.edu.au)

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### About the project

The [Learning to Teach Online](#) project is a free professional development resource designed to help teachers from any discipline, whether experienced in online teaching or not, to gain a working understanding of successful online teaching pedagogies that they can apply in their own unique teaching situations. It hopes to encourage dialogue, discussion and the sharing of ideas about online learning and teaching across disciplines and between institutions around the world.

### About COFA Online

COFA Online is an academic unit at the College of Fine Arts (COFA), The University of New South Wales (UNSW), Sydney, Australia. It has been innovating online pedagogy, academic professional development and effective online learning strategies since 2003.

### About The University of New South Wales

UNSW has an enrolment of approximately 40,000 students, and is the leading international university in Australia with over 10,000 international enrolments from over 130 nations. UNSW was also ranked as the top university in 2009 in the Australian Government Learning and Teaching Performance Fund for the quality of its teaching.

### Australian Learning and Teaching Council



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