

## Responding to Our New Students: Flexible Remote Laboratories for Regional Learners

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***Abstract:** Just as engineering practice is changing at an ever increasing pace, so are our students. They are no longer content to sit as one among a faceless crowd at set times in set places. The pressures of work commitments, as well as different learning styles means that a different approach is required. The hardest aspect of this are the laboratories required as part of the accreditation process. This paper discusses the use of flexible remote laboratories to help meet this challenge, particularly with labs that require consumables.*

### The New Engineering Student Cohort

Across Australia in engineering education there has been a shift in demands of teaching style from new cohorts of students. They are Generation Y, and as such, have been identified as kinaesthetic learners or “that they learn best through doing, experiencing, or being involved” (DEEWR 2008, p12). These students typically grew up with technology and therefore expect it to be an integral part of their learning. Students now also expect to be working with industry-relevant software and up to date laboratory facilities. Unfortunately, this is not always the case in a lot of situations (DEEWR 2008, p10).

It has also been found that 63.2% of students are working part time throughout the semester with a further 5.9% working full time and studying engineering (DEEWR 2008, p17). At CQUniversity our demographic creates a higher proportion of students working full time, particularly in our flexible learning enrolments. These students enrolled in our flexible learning programs are one of CQUniversity’s growing markets. To continue growing this market our programs need to be attractive to the flexible learning student and therefore must adapt to suit their learning needs.

As a result of these pressures, students are demanding that they learn in their own time at their own pace. Students want the flexibility within their programs of study to enable integration of study into their daily lives as they see fit, in their own personal way.

The recent report from the Department of Education, Employment and workplace relations in 2008 (DEEWR 2008) highlighted a number of areas that have been identified as possible areas to improve learning and teaching. It reports that students identified a lack of practical activities during the course (DEEWR 2008, p10). This goes against the primary motivations for students to study engineering being that they enjoy problem solving, designing and creating, that they see skills applied in a practical, hands-on way and that they are interested in new and emerging technologies ((DEEWR 2008, p19). Once these students hit a large proportion of universities across Australia these needs aren’t unfortunately met.

Students want cutting edge technology in their laboratories as they feel that the outdated technology currently used in most labs is a deterrent to effective learning and no longer relevant in the modern workplace ((DEEWR 2008, p3).

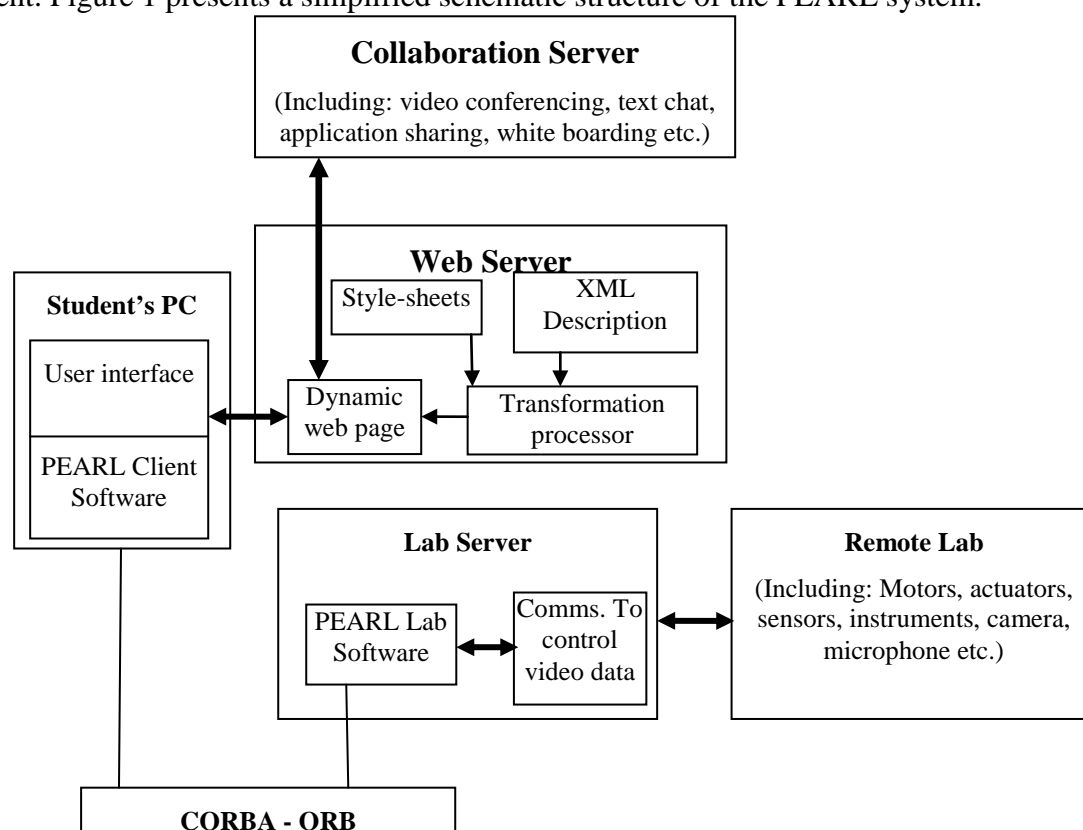
We at CQUniversity, as a modern regional university, are changing our strategies and curriculum to respond to these challenges. Our solution to some of these issues is to use remote laboratories. Remote labs offer the ability to deliver flexible learning environments to help all students, but particularly regional flexible or off campus students, to achieve practical learning outcomes. These remote labs do this by allowing students to undertake controlled experimentation on state of the art equipment in their own time, at their own pace.

## The Current State of Remote Laboratories

Remote laboratories are essentially internet delivered activities to help facilitate learning (Lindsay 2004, Trevelyan 2003). The rise of the internet and general information technologies has had a major impact on teaching and learning. For example Yeung and Huang (2003) developed a remote access control system which allows users to perform control experiments via internet. The experiment utilised a DC motor control set up which can be accessed simply by navigating to it with any web browser.

Scanlon et al. (2004) developed a remote laboratory system. The purpose of the system was for students to conduct a range of experiments in science and engineering. The lab was set up specifically for those students that were unable to attend the conventional laboratory. There were a variety of reasons, such as disability, and flex-mode students for non-attendance.

Scanlon was working on a project called “Practical Experimentation by Accessible Remote Learning” or PEARL. The aim of PEARL was to develop a remote laboratory system at the Open University, UK. PEARL was a complex system that consisted of a network, server, interface technologies, equipment, control technology, video cameras, microphones and streaming technologies. All of these technologies are required to be consolidated into one seamless unit to form the remote laboratory. This system in particular allows the student to be able to see the laboratory via video stream, and to communicate with their peers about the experiment. Figure 1 presents a simplified schematic structure of the PEARL system.



**Figure 1: PEARL System, Scanlon et al. (2004).**

## **Why Remote Laboratories at CQUniversity Engineering**

CQUniversity currently has a wide variety of programs ranging from Associate degrees through to Bachelor degrees. Many of the programs are multi-campus and are currently being offered both internally and in flexible (external) delivery modes.

Previous solutions at CQUniversity for multi-campus and flexible delivery modes have utilised residential schools and external laboratory kits. While these solutions are working, they come a major drawback, both are resource hungry, in the form of requiring staff and funding.

Residential schools in particular require sessional staff and academic staff. These staff facilitate and guide student learning in the laboratory environment. They are traditionally run during the semester breaks and as such, take valuable time from academics who are juggling teaching and research activities. Sessional staff also incur an extra cost to the university. CQUniversity has a large demographical market. Significant costs of travel and accommodation burden many of our interstate students when they are required to attend residential schools.

In some programs, kits are sent to students. The monetary value of such kits can be high. Logistical processes and staff have to be in place to facilitate the loan of such kits. Recovery and testing of returned kits adds yet another dimension, and time expensive operation, to the maintenance of such kits.

The use of remote laboratories can reduce sessional staff costs, release academic staff time and slash equipment\kit associated costs, (Lindsay and Good 2006). If incorporated correctly into the existing curriculum remote laboratories also allow students to study and learn at their own pace, allow for more flexibility in experiments, provide the opportunity for multiple attempts and give more feedback through video and operational logs from the experiments themselves, (Trevelyan 2003, Lindsay 2006). With these enhanced abilities CQUniversity intends to start incorporating remote laboratories into its engineering curriculum.

## **What are we proposing?**

At present we are proposing to use remote laboratories to engage students to meet the learning objectives in their programs of study. To do this CQ University will require a system such as that implemented in Scanlon et al. (2004) or Trevelyan (2003). Such systems will allow flexible students to use the internet to undertake mandatory assessed laboratories in a safe and meaningful manor. They will have the ability to learn at their own pace and can choose at which times and what order they will undertake particular laboratories.

We are proposing two forms of remote laboratories for CQUniversity, those that have fixed resources and those that require consumables. CQUniversity has a number of streams in its engineering field such as Mechanical, Electrical, Civil and soon Mining. This will require a diverse set of remote experiments and an equally diverse remote laboratory.

Currently at CQUniversity, we have been using programmable humanoid robots in our first year courses to help students develop problem solving skills. The students are required to create a program that makes the robot dance to their own choice of music. Students are required to first use a simulator to create and test the program before they are allowed to actually test and iterate their routines on the actual robots.

While this worked well for internal students on campus, the off campus FLEX students were only able to simulate the code. The FLEX staff then downloaded the dance routines for each external group to the robot and videoed the dance. Then had to transfer the video to the computer, compress and finally email the video to the student. This turned out to be a repetitive and time consuming activity.

We are planning to integrate the robot dancing project into a remote laboratory and have it run via the web real-time so that students themselves can upload files and run their routines on the robots and view the robot real time over the web.

In our new Geoscience and Mining engineering courses a hardness experimental has been planned. This experiment is usually destructive to the sample being tested. As a result the test cannot be done multiple times on the same sample. A fresh sample for each student must be supplied; this generates some new challenges for remote labs as we would like some of our experiments to be able to deal with consumables.

We aim to provide a hardness experiment that scratches the surface of different minerals real time. At this stage we would like to provide different materials and have the student grade the samples based on abrasion as given by Mohs' Scale, Keller (2008). To do this some example of Moh's scale would likely be required. This will be a challenging and interesting new slant on remote laboratories.

## **Ensuring the Educational Value of CQ University's Remote Laboratories**

CQUniversity engineering aims to use its proposed remote laboratories to respond to students with different learning styles and needs, including at their own pace and time. This should not disadvantage students with work commitments or disabilities but rather provide a level of flexibility that residential schools cannot.

Using the internet, something generation Y is very comfortable with, exercises some of the computer literacy skills that employers are seeking but also tackles generation Y's need and hunger for the use of technology. Such remote labs add a new dimension in freedom for students.

CQUniversity's vision for its programs is to include remote laboratories in its project based learning environments. Once we have the remote laboratories we will also have the capability to run both remote and non remote labs of the same kind to try and gauge the effectiveness of our labs. Students' reflective journals will likely be a good source of feedback as the effectiveness of remote laboratories.

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