THE OLD WAY

Since WWII, the teaching of practical science at Australian universities has changed very little. Practical science is still mostly taught by discipline, and even basic chemistry is often taught as several different skill sets; analytical, inorganic and organic. Biology is taught as biochemistry, molecular biology and various flavours of clinical chemistry including blood pathology and chemical pathology. In most universities, each of these skills is taught in separate small laboratories, many of which have very low rates of room utilization. These labs are expensive to build and maintain, consume vast amounts of energy and water, require a lot of staff input and offer poor student experience. In many cases, the teaching laboratories at universities compare unfavourably to labs in high schools.

The image on this page shows an inorganic chemistry teaching laboratory in active use at an Australian university until the end of 2014. It was built in 1958. Image: ARINA/WHP Architects.
THE SUPERLAB

The alternative to traditional discipline based science is the Superlab; a multidisciplinary practical lab with high levels of AV support and space for 200 to 300 students. The new space type is often combined with a more flexible approach to the commencement and completion of experiments to give students more flexibility. These labs are designed to allow students to work alone or in teams and provide support space for learning activities, safety briefings and PPE. Transparency and views contribute to high levels of amenity.

The image shows a proposal for a new 128 place Superlab within an existing building at an Australian University. Image: ARINA Hayball.
ARINA Hayball is a leading architectural consultancy in the HE sector across Australia and SE Asia. We have been active in the scoping, design and delivery of Superlabs since 1992, delivering our first multi-disciplinary lab in 2002 for the University of Sydney. We believe that teaching laboratories should be an enriching environment for students, safe and convenient for staff and students, with high levels of amenity. Labs should be adaptable to different teaching and learning styles and be economical and efficient to operate. Wide aisles suit trolleys for set up and clean up and increase the feeling of space for students; they also make the labs safer, reducing the frequency of accidents caused by collision.

AV and IT support is an important part of the Superlab. AV provides support for virtual experiments, virtual dissections and IT provides support for on-line lab notebooks and safety information. Image: ARINA Hayball.
The new Superlab at London Metropolitan University has provided a large scale demonstration of the potential of the Superlab, but we should not forget that the Superlab has been used in Australian universities for nearly 20 years. Charles Darwin University established a Superlab in 1997, ARINA designed and delivered a Superlab for the University of Sydney (now Charles Sturt University Orange campus) in 2003 and Bond University has taught science in a Superlab since the inception of its medical degree in 2004. In 1996, ARINA began the process that led to the opening of the new UTS Superlab in 2015.

Image: London Metropolitan Superlab, 280 places. This was developed in 2006 at a cost of £30M (AUD $57M).
Typically, the delivered cost of a new practical science laboratory will be between $6,000 and $10,000 per sq m (GFA), excluding equipment. With recent Australian Science buildings showing net-to-gross factors ranging from 1.5 to 2.0, the cost of a yielded sq m Usable Floor Areas (UFA) can be over $20,000. This means that the capital cost of providing a single new undergraduate (UG) place in a practical laboratory can easily exceed $250,000, including preparation areas and circulation. This of course does not include the equipment, consumables and academic and professional staff expenses necessary to make the lab operational. Achieving high rates of utilization is a necessity to ensure that science can be taught economically.

AV and IT support is an important part of the Superlab. AV provides support for virtual experiments, virtual dissections and IT provides support for on-line lab notebooks and safety information. Image: ARINA Hayball.
NEW PEDAGOGY IN SCIENCE

According to Professor Paddy O’Toole of Monash University, joint author of a report prepared for the Council of Australian Deans of Science in 2009 (Tertiary Science Education in the 21st Century, 2009), at least half of students enrolled in science subjects are doing non-science degrees. The benefits of teaching complex lab techniques when half the students involved will probably never have an opportunity to use them is questioned by the study. More pithily, one of the students interviewed for the study said: “I don’t see how the practice of being able to dribble something into something else and turn it into something else makes any difference to your ability to understand theory…”

*Image of the trial UTAS Superlab: Image ARINA Hayball*
THE CASE FOR THE SUPERLAB

Over the past 20 years, a large number of influential scientists have called for a revolution in the practice of science with the aim to create scientists who can work more effectively in interdisciplinary teams. This has developed from a growing realisation that most scientific innovations since the start of the twentieth century have involved interdisciplinary effort. The discovery of DNA is perhaps the best-known example, relying, as it did, on the combined skills of a couple of biologists, a physicist and a chemist.

The need for a more effective interdisciplinary response is a frequent issue in applied research, particularly where teams need to work fast to develop responses to issues as diverse as beating Ebola or delivering a better battery for electric cars. Climate science has also developed into a focus of an interdisciplinary effort.

Campus UFA Reductions

An Australian University campus of 25,000 EFTSL will typically have approximately 30% of UFA dedicated to laboratory and workshop functions, both in teaching and research. Consolidating all science teaching functions will free up 1/7th of all laboratory and workshop areas, or 4% of the total campus UFA.
Teaching Laboratory Reduction

The space efficiencies as a result of moving from Traditional Laboratory Teaching to Superlabs will generate a 25-30% reduction on all laboratory teaching spaces. This will further lead to reduced demand and space reductions for ancillary spaces such as store room and preparation areas.

Increased Class Size and Interaction

A larger classroom for laboratory teaching will lead to operation benefits such as reduced prep times, reduced number of rooms, and less duplication of similar spaces. It will allow for the planning of more contemporary practical science teaching pedagogies, including AV enabled teaching and interdisciplinary science teaching.
ADVANTAGES OF THE SUPERLAB

This modern Superlab is predicated on a number of key factors:

1. Improved learning outcomes.

2. A substantial increase in room utilisation across many disciplines to support the business case for the capital expenditure.

3. Availability of IT and AV infrastructure to support self paced learning with a large cohort.

If STEM academics from different disciplines can be encouraged to work together to maximise the opportunities that these facilities offer, the benefits are compelling:

- A huge reduction in the area devoted to UG laboratories, perhaps by as much as 75 per cent over existing discipline based laboratories.

More efficient use of laboratory technical staff with the opportunity to develop a career structured around the acquisition of a wider variety of skills.

- A reduction in the cost of consumables and the total amount of academic hours required to support practical teaching efforts.

Image of the trial UTAS Superlab: Image ARINA Hayball
SUPERLAB FEATURES

Transparent teaching spaces provide an environment that is conducive to group discussion and collaborative learning. Light and airy, they are a far cry from the dismal gloomy labs of yesteryear.

Here, students may learn and discuss the theoretical component of an experiment, before going to conduct it in the adorning lab space. They may then return here to write-up, discuss and collaborate with team members.

While all of this is going on, other students and visitors may have a glimpse into what others are doing, sparking intellectual curiosity and promoting the sense of being part of something greater. Informal space encourages interaction and circulation, all part of a great campus experience.

Support lab areas work in the background; efficient and unobtrusive, they are nonetheless essential to ensure everything runs smoothly.

Amply supplied with communal specialised equipment and services (autoclaving, washing, etc) they eliminate the redundancy of having separate machines. This also prevents the tendency towards ‘territory building’.

This consolidation of facilities and services frees up space that can be better used for other purposes- such as post-graduate Superlabs and research rooms.
Large open plan labs are at the core of every good science facility. Equipped with workstations, generic lab benches that can be used across disciplines, and wet sinks, each student is allowed ample space to type, write and conduct experiments. It’s also easy to work in teams; stools can simply be spun around to face each other.

The layout of the labs allows an instructor to be clearly visible from every seat, making it easy to capture the attention of a class for a demonstration or to deliver an engaging lecture. Benches are set at right angles to external walls to allow optimal access to sunlight.

Unlike a traditional lab, there is no need to move to a different room to type up data; results can be entered and recorded real time as the experiments are happening. A flexible solution to an age-old problem.

Strong lab management is key to maintaining a fruitful and coherent Superlab experience. The busy nature of a top-class facility should have management to match.

Hayball recommends engaging the services of a full-time Lab Manager, who will choreograph the complexities of running a state-of-the-art laboratory environment.