



Promoting excellence in higher education

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## Retrofitting university learning spaces

### Final report

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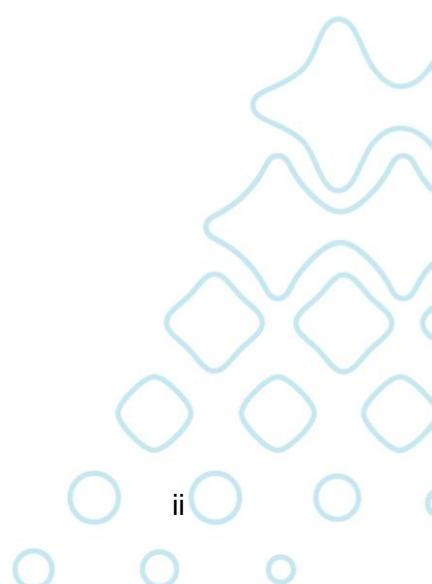
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## Executive summary

The ‘Retrofitting university learning spaces’ project set out to address the question: How do we redevelop original university classroom spaces to support new ways to enable and facilitate student learning in a cost effective manner?

In recent years, a number of universities have developed and evaluated signature learning spaces designed to support a range of existing and emerging approaches to learning. While adopting a range of innovative design strategies, the high cost of these facilities limits the construction of ‘high-tech’ spaces to a few institutions. The reality for most students and academics is that their formal learning activities occur in rooms “configured for a teacher to be seen and heard and for students to take notes” (Van Note Chism, 2002, p. 9). This project explores the principles behind modern learning spaces with a view to producing both theoretical and practical guidance to developing models for retrofitting existing spaces to support more active, collaborative and peer-based approaches to learning.

The first major outcome of the project was the development of a coherent and well-grounded set of design principles that could be used to guide the redevelopment of existing spaces. Commencing with the key literature in the field and using accepted principles of learning, space and technology the team derived an extended set of principles. These principles were then filtered by analysis of perspectives from key stakeholders: students, academics, professional and support staff. Ultimately the project produced a set of eight principles that, while not unlike other principle sets, provide a clear grounding to their validity and utility. The final set of principles are consistent with academic and student ambitions for learning outcomes and are coherent to those responsible for the design, development and ongoing management of learning spaces. These principles are:

### **Engagement Principles**

- Principle 1: Spaces should support a range of learners and learning activities.
- Principle 2: Spaces should provide a quality experience for users.

### **Empowerment Principles**

- Principle 3: Spaces should help foster a sense of emotional and cultural safety.
- Principle 4: Spaces should enable easy access by everyone.

### **Ease of Use Principles**

- Principle 5: Spaces should emphasize simplicity of design.
- Principle 6: Spaces should integrate seamlessly with other physical and virtual spaces.

### **Confidence Principles**

- Principle 7: Space should be fit-for-purpose, now and into the future.
- Principle 8: Spaces should embed a range of appropriate, reliable and effective technologies.

This background work guided the redevelopment of a number of existing spaces. Queensland University of Technology (QUT) redeveloped five central classrooms and a connecting corridor in a building originally built in 1970. Charles Darwin University (CDU) converted an old general-purpose computer-teaching space into a 50-person flexible wireless lab for information technology, architecture and engineering students. The redevelopment of these spaces demonstrates the

possibility to retrofit existing learning spaces in a cost effective way, while better enabling new and emerging forms of learning.

Ultimately the project presents a series of theoretical and practical resources available via the project website  
[<http://learnline.cdu.edu.au/retrofittingunispaces/index.html>](http://learnline.cdu.edu.au/retrofittingunispaces/index.html).

These resources include a report on the development of the eight key design principles; a report containing 25 simple ideas for implementing the principles; and a multimedia kiosk that covers redevelopment case studies and contains development plans, detailed descriptions of all design elements used, a gallery of redevelopment images, and an overview of evaluations of these spaces.

In providing a series of workable and easily implementable learning space redesign solutions, the results of the project also reveal the importance of ensuring that attention is given to successfully build students' and academics' capability to use these new spaces.



## Project outcomes and impacts

The main aim of the project was to develop scalable and transferable solutions to the question: How do we redevelop existing university spaces to facilitate new styles of learning in a cost effective manner? The project committed to a number of key outputs including:

**Output 1:** A report outlining principles for cost effective redevelopment of existing spaces.

**Output 2:** A repository of student, academic, and professional and support staff perspectives on learning spaces.

**Output 3:** A portfolio of resources arising from the project:

- outcomes of the institutional case studies
- evaluation rubrics for post occupancy evaluation of spaces
- resources to support the use of next generation learning spaces
- roadmaps for technology utilisation in learning spaces
- ideas for anyone involved in the redesign and redevelopment of spaces.

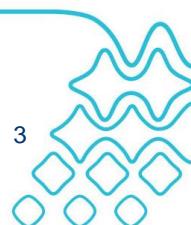
**Output 4:** A one-day colloquium to share project results.

The following sections provide an overview of each of the project outcomes and how they contributed to the overall goal of the project.

### Principles for the costs effective redevelopment of existing spaces

The first major outcome of the project was the development of a coherent and well-grounded set of design principles that could be used to guide the redevelopment of existing spaces. The recent literature on learning spaces is replete with suggested principles for learning space design (Jamieson, Fisher et al. 2000; Brown and Lippincott 2003; Johnson and Lomas 2005; Long and Ehrmann 2005; Higher Education Funding Council for England 2006; Milne 2006; Oblinger 2006; Scottish Funding Council 2006).

Despite their abundance, the evidence that any specific design principle, design approach, or design model is better than another or is proven to lead to better learning outcomes is still being debated in the literature. Reviews of the 'evidence' to date suggests that much of it is largely anecdotal or based on casual observation (Temple 2007). Despite this, the evidence that new pedagogies provide better learning outcomes is relatively strong by comparison and most institutions involved in small-scale greenfields developments are comforted by the belief that new space is an essential element to supporting new pedagogies, and therefore warrants the investment being made. Large-scale redevelopments of existing spaces bring into sharper focus questions of scalability and maintainability, and demand a smaller more manageable set of demonstrable principles.



This report commences with an exploration of the wide array of learning space guidelines and principles available in recent literature from the three related principles of pedagogy, space and technology (Radcliffe, Wilson et al. 2009). Following the literature review, the principles identified were filtered through the 'people lens' of various key stakeholder groups associated with the design, use and ongoing management of learning spaces – students, academics and professional and support staff. Ultimately this report produces a condensed set of principles that the project team hopes are consistent with academic and student ambitions in terms of learning outcomes; and that are also coherent to those responsible for the design, development and ongoing management of learning spaces. The report is available via the project website  
[<http://learnline.cdu.edu.au/retrofittingunispaces/index.html>](http://learnline.cdu.edu.au/retrofittingunispaces/index.html).

## A repository of perspectives on learning spaces

The second major outcome of the project was the collection of a broad set of perspectives pertaining to the desirable elements key stakeholders valued in the design of university learning spaces. Views and perspective were sought from three key stakeholder groups:

- students
- academics
- professional and support staff.

The study captured students' perceptions and experiences of learning spaces and places through a photo elicitation exercise at all three participating institutions (QUT, CDU, Edith Cowan University). Photo elicitation involved encouraging students to take photos of a range of spaces based on a number of prompting questions including:

- the worst space or place on campus
- the best space on campus
- the best classroom on campus
- the worst classroom on campus.

Images with associated set of comments and reflections have been loaded into Flickr (<http://www.flickr.com/>) and can be accessed via the project website.

To facilitate consideration of the academic perspective of learning spaces, 30 academics were interviewed from both CDU and QUT. The academics were purposively selected based on their level of activity engagement in the current learning spaces debate at each institution. Academics interviewed ranged from tutors through to professors covering a range of different disciplines including education, engineering, information technology, library sciences, creative industries, Indigenous studies and nursing. Interviews involved semi-structured questions loosely based on the following key areas:

- What do you think constitutes a good learning space?
- Describe for me an ideal learning experience in one of your classes.
- What about our current spaces aids or impedes your ideal learning experiences?
- What advice would you give space designers?

A summary of the results of these interviews is contained in the learning design principles report and extracts of the videos can be accessed on the project website.



## A portfolio of resources arising from the project

The project website provides a portal to all the resources developed as a result of the project. The first major collection of resources available via the website consists of the reports and publications developed during the project. These resources cover both theoretical and practical aspects of learning space redevelopment and include:

- ‘Retrofitting university learning spaces: Design principles for the cost effective redevelopment of existing spaces’.

This report starts with an overview of the literature surrounding learning space design principles, identifying some 46 principles that might be used to guide learning space redevelopment. This unmanageable collection of principles is then refined based on a consideration of the perspectives of three key stakeholder groups: students; academics; and professional and support staff. Based on this refinement, the report concludes by outlining a compact set of principles that might be successfully used to assist the redevelopment of existing university learning spaces

- ‘Evaluating university learning spaces: A literature review of recent approaches’.

This report presents a literature review of recent approaches adopted to help evaluate university learning spaces. The report provides a summary of some of the key overall approaches utilised to consider various aspects of learning space design, usage and utility before concluding with some useful exemplar of current learning space evaluation instruments.

- ‘Eight key principles to guide the redevelopment of university learning spaces’.

This short report provides an introduction to the eight key principles derived by the project to help guide the redevelopment of existing learning spaces. The report provides a succinct outline of the principles, explaining both what the principles cover as well as why they are useful.

- ‘Twenty five simple ideas to use in the redevelopment of university learning spaces’.

This short report complements the eight key principles report by providing 25 ideas that can be used in the redevelopment of existing university learning spaces. The report focuses on practical, cost effective and easily implementable solutions that can be adopted by almost any institution. This report is also presented as a separate part of the project website using wiki technology encouraging the broader learning spaces community to comment on the utility of each idea and to their own ideas to the collection.



The second major resource collection available via the website is contained within a purpose-built, multimedia exhibition displaying the plans and results of actual space redevelopments undertaken at each of the partner institutions. The multimedia exhibition provides access a wide array of imagery, videos, plans and data including:

- development plans and layouts for each of the spaces redeveloped as part of the project
- summaries and images of all the design elements used in each project including key technologies and furnishings
- a gallery of images collected before, during and after each of the space redevelopment activities
- a report card on the redeveloped space based on post occupancy evaluations.

The idea of the resource is that it can be used in conjunction with key reports like the 'Eight key principles' and '25 simple ideas' to help inform both the design and redevelopment of existing learning spaces. The exhibition provides a highly visual and engaging way of demonstrating some of the key project outcomes.

The website also enables access to another purpose built repository of learning space imagery that extends beyond just that collected as part of the space redevelopment. The repository not only presents a collection of useful imagery but also allows users to tag key elements in each image with comments and thoughts. This photo tagging repository will be made available more broadly on conclusion of the project.

Finally the website also provides access to the resources associated with the repository of stakeholder perspectives on learning spaces including student photos and academic and professional staff interview videos.

## Colloquium

On 26 October 2009, a one-day project colloquium was held at QUT. Forty participants from 18 universities and two architectural firms participated in a day-long workshop designed to provide an opportunity for participants to:

- review the results of the stakeholder analysis conducted to date
- help refine the design principles developed as a result of this analysis
- engage with the practical design elements utilised in one of the spaces redeveloped as part of the project
- consider how the design principles and practical outcomes might be applied at their own institutions.

The aim of the day was to seek input from a broad spectrum of people actively engaged in the different aspects of learning space design and development to help refine the results of the project at that time. Participants were selected based on the level of their involvement in learning space redevelopment projects at universities across Australia and included academics, academic developers, facilities managers, IT and audio visual (AV) managers, library managers and architects.

Participants generously provided valuable input into the projects design principles and the results of this input are reflected in the final set of refined principles developed. In return participants were given a copy of the multimedia exhibition developed for the QUT space.



## Approach and methodology

The project approach involved a range of participative activities between the partner institutions as well as institutionally based activities within each institution. The overall methodology for the project consisted of three main phases:

- Phase 1:** Development of design principles based on a review of the literature and consideration of stakeholder perspectives.
- Phase 2:** Redevelopment of selected case study sites at each institution based on the principles.
- Phase 3:** Development of website and online repositories to store project results and resources.

It is important to note that these phases were not intended to be sequential or independent of each other. Design principles, for example, were continually refined based on the outcomes of the case study developments, the one-day colloquium and ongoing analysis of stakeholder perceptions and post occupancy evaluations.

### ***Phase 1: Developing design principles***

Design principles for learning spaces have received considerable attention in the last eight to 10 years with a number of well-cited authors presenting principles and guidelines intended to encourage the development of 'next generation' learning spaces (Jamieson, Fisher et al. 2000; Johnson and Lomas 2005; Long and Ehrmann 2005; Higher Education Funding Council for England 2006; Oblinger 2006). These principles are often presented in order to help institutions develop spaces that respond to emerging pedagogies which see learning as a more active, collaborative and engaging activity. The principles cover a wide range of topics, but there are some common themes:

- design for learners and learning, not technology
- support a range of different pedagogical approaches
- be creative and bold and look beyond present demands
- plan for technologies brought into the space
- allow for greater levels of learner control of spaces.

Despite the apparent attractiveness of these principles, recent reviews of the 'evidence' behind them suggest that much of it is largely anecdotal or based on casual observation (Temple 2007). It has been proposed that part of the reason for this may be the impossibility of developing a universal set of design principles. In an attempt to address this problems, Radcliffe et. al. (2009) present the pedagogy-space-technology (PST) framework that suggests that spaces can best be understood from these three interrelated perspectives.

If we start from the pedagogical premise that learning space design should be learning focused (Long and Ehrmann 2005; Oblinger 2006; Bergsagel, Best et al. 2007), then the ideal starting point must be based on supporting a set of desired or 'ideal' learning behaviours. Starting with Chickering and Gamson's 'Seven Principles' (1987), a range of different learning principles have been presented in the last few years (American Association for Higher Education, American College Personnel Association et al. 1998; Bransford, Brown et al. 2000; Carmean and Haefner 2002). Scott-Webber (2004) suggests that learning principles like those developed by the American Association for Higher Education and others (American



Association for Higher Education, American College Personnel Association et al. 1998) provide a useful starting point for the derivation of design principles for learning spaces.

**Table 1:** Learning space design principles derived from learning principles

Learning principles:	Derived learning space principles
1. <b>Learning is</b> about making and maintaining connections	<b>Learning spaces should</b> make it easy for students to access relevant resources and learning materials <b>Learning spaces should</b> support easy interaction between students and with academics
2. <b>Learning is</b> enhanced by taking place in the context of a compelling situation	<b>Learning spaces should</b> help create a sense of stimulation and excitement <b>Learning spaces should</b> reflect the values of the institution
3. <b>Learning is</b> an active search for meaning by the learner	<b>Learning spaces should</b> support student construction of knowledge <b>Learning spaces should</b> support active engagement rather than passive receipt of knowledge.
4. <b>Learning is</b> developmental, a cumulative process, integrating new with the old	<b>Learning spaces should</b> make it easy for students to build from previous knowledge <b>Learning spaces should</b> make it easy for students to share knowledge
5. <b>Learning is</b> done by individuals who are intrinsically tied to others as social beings	<b>Learning spaces should</b> support high degrees of movement, activity and interaction <b>Learning spaces should</b> be flexible enough to support both individual and group activities
6. <b>Learning is</b> strongly affected by the educational climate in which it takes place	<b>Learning spaces should</b> be safe, comfortable and free from external distractions <b>Learning spaces should</b> assist learners to be an active part of the university community
7. <b>Learning requires</b> frequent feedback if it is to be sustained, practice if it is to be nourished, and opportunities to use what has been learned	<b>Learning spaces should</b> facilitate academics in monitoring and engaging students in their learning <b>Learning spaces should</b> facilitate academics providing feedback on student activity
8. <b>Much learning</b> takes place informally and incidentally	<b>Learning spaces should</b> cluster formal and informal spaces to support easy transition <b>Learning spaces should</b> support opportunities for accidental or serendipitous interaction between students and academics
9. <b>Learning is</b> grounded in particular contexts and individual experiences	<b>Learning spaces should</b> be cognisant of cultural requirements and celebrate diversity <b>Learning spaces should</b> assist the connection of the university as a broader community of learners
10. <b>Learning involves</b> the ability of learners to monitor their own learning	<b>Learning spaces should</b> allow students to capture learning outcomes for later review <b>Learning spaces should</b> help draw out reticent students

A similar exercise can be undertaken from the space perspective utilising common principles found in the fields of architecture and design (American Society of Interior Designers 2001) Utilising the work of Simmons (2009), the chief executive for the Commission for Architecture and the Built Environment in the UK, we can again derive a set of principles for the design of learning space



**Table 2:** Learning space design principles derived from space design principles

Learning principles:	Derived learning space principles
1. Space should be useful, built to last and easy to maintain	<b>Learning spaces should</b> be robust and fit for ongoing use <b>Learning spaces should</b> be designed giving due consideration to ongoing maintenance of the space
2. Spaces should facilitate quality of life for the users	<b>Learning spaces should</b> be a healthy working and learning environment <b>Learning spaces should</b> minimise any consequences and risks associated with accidental or unintended actions
3. Spaces should be easy to move around and allow users to find their way	<b>Learning spaces should</b> be easy to access and navigate for all users <b>Learning spaces should</b> encourage the notion of simplicity in exercising control over events in the room and its systems
4. Spaces should relate well to other spaces	<b>Learning spaces should</b> be (re)designed in conjunction with planning for adjacent spaces <b>Learning spaces should</b> allow for a flow of pedagogical activities in and around them rather than an unconnected set of learning events
5. Spaces should be flexible and respond to changing use over time	<b>Learning spaces should</b> support a range of different learning activities without the need for excessive reconfiguration <b>Learning spaces should</b> be easily reconfigured to support new and emerging learning requirements
6. Spaces are environmentally efficient	<b>Learning spaces should</b> be designed to utilise resources and technologies that are environmentally sustainable <b>Learning spaces should</b> support users to learn about and be environmentally conscious in their learning activities
7. Spaces should help their user to work more effectively	<b>Learning spaces should</b> facilitate easy movement of learners around the space <b>Learning spaces should</b> create minimal cognitive dissonance for their users
8. Spaces should prompt users to express pride or delight in their use	<b>Learning spaces should</b> convey a sense of engagement and excitement <b>Learning spaces should</b> encourage a sense of ownership by both staff and students

Finally in the technology arena, well accepted principles for technology design have been developed over the last 20 years (Schneiderman 1992). These principles have influenced aspects of technology design ranging from hardware design through to software design (see for example ISO Standard 9126 Software Quality Model) to more recently influencing website design and usability standards (Nielsen 1999) . While the actual number and compositions of the principles have been altered slightly over time, their general thrust has stayed the same allowing another set of learning space principles to be derived:



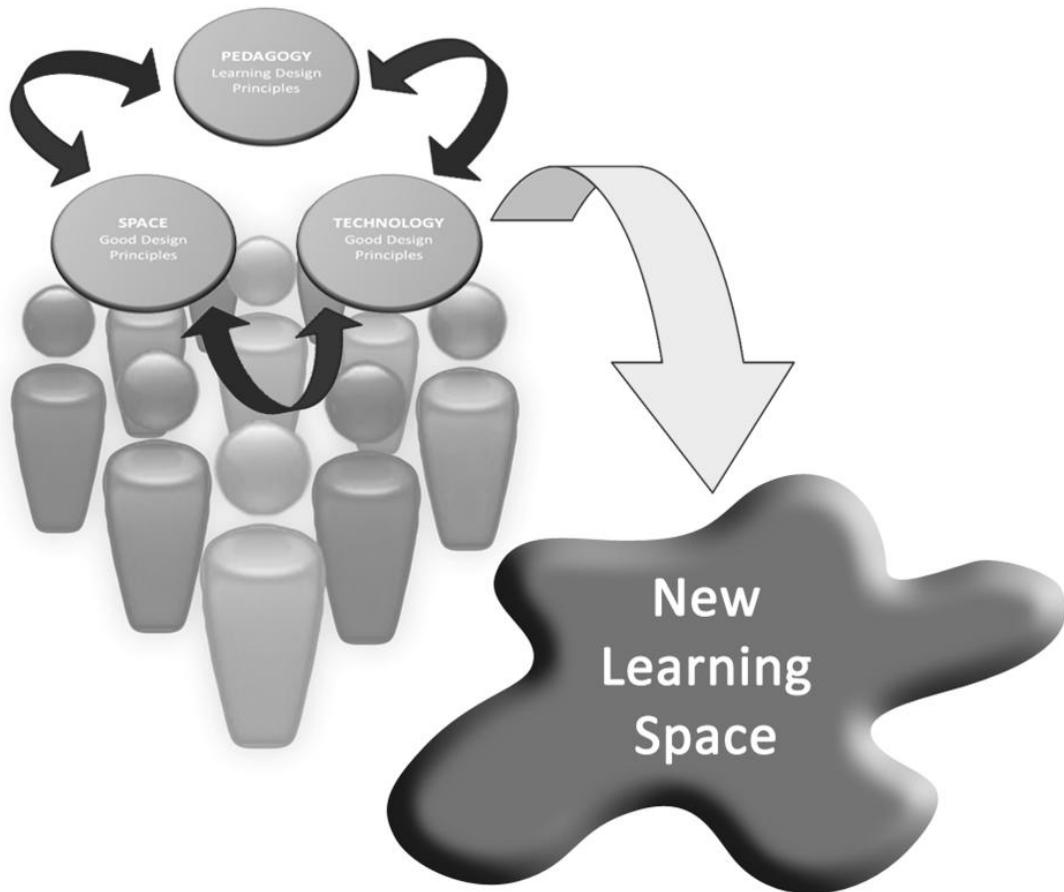
**Table 3:** Learning space design principles derived from technology design principles

Learning principles	Derived learning space principles
1. A system or solution should be easy for a novice user to learn and an experienced user to use its advanced functionality	<p><b>Learning spaces should</b> include elements that assist the learning efficiency and efficacy of its users</p> <p><b>Learning spaces should</b> allow the user to focus on the learning activities to be conducted and not on the learning activities required to use the space</p>
2. A system or solution should deliver the function necessary for its users to achieve their desired objectives	<p><b>Learning spaces should</b> be designed based on a clear vision and understanding of users needs</p> <p><b>Learning spaces should</b> be designed using robust design, test and implement procedures</p>
3. A system or solution should withstand the rigours of constant operation as well have some ability to adapt to changing circumstances	<p><b>Learning spaces should</b> be designed giving due consideration to ongoing maintenance of the space</p> <p><b>Learning spaces should</b> be constructed with flexible elements that do not constrain its ability to adapt to changing needs</p>
4. A system or solution should be dependable and provide the user with the necessary confidence that it will be available when required	<p><b>Learning spaces should</b> utilise technology to proactively monitor that state of the space and its systems</p> <p><b>Learning spaces should</b> be easily identified allowing users to find suitable spaces</p>
5. A system or solution should be able to respond to relevant peak demands and be available in a cost effective manner to support its broadest possible use	<p><b>Learning spaces should</b> have sufficient resources for all users of the space irrespective of the configuration</p> <p><b>Learning spaces should</b> be adequately supported by services that allow additional learning resources to be easily allocated</p>

Given that many of these derived principles are closely related, an amalgamation reveals a collection of some 25 design principles for new learning spaces. While providing useful guidance for the redevelopment of learning spaces, feedback suggested that these ‘principles’ were perhaps more like guidelines or protocols than fundamental principles. To develop a final set of principles, greater consideration was needed in terms of the both the nature of the principles, and the way in which they resonate with key stakeholders in learning space design, development and utilisation.

While implicit within the University of Queensland pedagogy-space-technology (PST) framework, it is important to recognise that these elements become real only through the involvement of a wide range of people. For students, learning spaces (formal and informal) represent an important element of their learning experience – they can help motivate and engage or they can act to distract and distance students from the learning ambitions. For academics, learning spaces can either enable or impede them in the design and delivery of new, innovative and high-quality learning activities. Finally, facilities management, information technology and audio visual professionals, architects, builders, and university finance and senior management all have an impact on the implementation of any design process.

If we consider this refinement to the original PST framework developed at The University of Queensland a revised framework can be conceived as follows in Figure 1.



**Figure 1:** General learning spaces framework

Using this refined framework, the principles identified in the previous exercise can be filtered through the people lens of various key stakeholder groups associated with the use and management of learning spaces: students, academics, and professional and support staff. This filtering process supports the production of a condensed set of principles that is consistent with academic and student ambitions in terms of learning outcomes, while remaining coherent to those responsible for the design, development and ongoing management of learning spaces.

Largely mirroring the Rochester photo elicitation project (Foster and Gibbons 2007), students at QUT, CDU and Edith Cowan University (ECU) were invited to participate in a project where they took photos of their 'best' and 'worst' spaces across each campus. To identify academic and professional and support staff perceptions a range of academics, facilities managers, IT managers, library managers and learning environment specialists were interviewed at QUT and CDU.

Analysis of student perceptions of learning spaces revealed a number of common themes:

- Spaces should have a positive ambience with physical characteristics of light, sound, temperature, colour and furniture carefully considered.
- Spaces should be accessible and available for a range of learning activities.
- Spaces should be easy to use and adapt, with appropriate technology available.



Analysis of academic perspectives reveals five basic themes:

- Spaces must first and foremost help engage students and support a range of different learning activities.
- Spaces should help ensure a quality learning experience.
- Spaces must be accessible and safe, both physically and psychologically.
- Spaces should be easy to use and integrate well with related spaces.
- Spaces should be supported by appropriate technology.

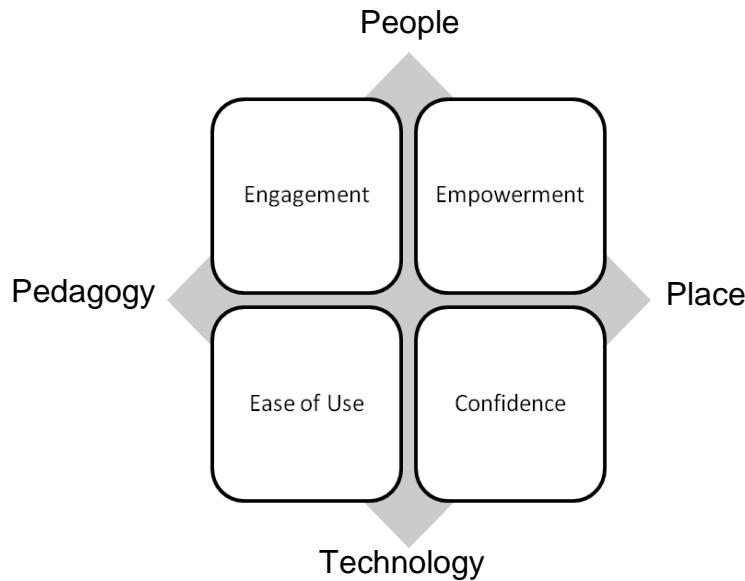
Finally, analysis of professional and support staff views reveals six major themes:

- Spaces need to be flexible enough to respond to a diverse groups of users and new and emerging approaches to learning.
- Spaces need to be of sufficient quality that they actively attract students and academics to use them.
- Spaces need to be simple to use and easily learned.
- Spaces need to relate well to the connecting spaces around them.
- Spaces need to be affordable, sustainable and maintainable both now and in the longer term.
- Spaces need to be supported by appropriate levels of useful technology.

When these themes are amalgamated, a number of common perspectives tend to stand out including supporting student engagement and interactivity, providing a high-quality environment, empowering users to achieve their learning goals and ensuring ease of use – all balanced against necessary technical and maintenance needs.

At the simplest level, the challenge of designing effective learning spaces becomes a classic usability and utility problem. A range of frameworks already exist in the fields of product design that offer a useful enhancement to the learning spaces PST framework. The LUCID framework (Kreitzberg 2008) suggests that the design of any interactive product requires attention to four key characteristics: engagement, empowerment, ease of use, and trust. With minor amendments to this last item, it is possible to overlay this framework on the PST framework and deliver a model that highlights many of the key elements necessary for the redevelopment of learning spaces.





**Figure 2:** Integrated model for learning space design

Consistent with recent developments in learning space design (Brown 2009) this model is not about 'stuff' but about what students and staff can do in learning spaces. The following sections describe each principle in more detail.

### Engagement

**Principle 1: Spaces should support a range of learners and learning activities**

**Keywords:** *agile, dynamic, adaptable, inspiring, stimulating, challenging, engaging*

Research has shown that deeper learning occurs when academics and students are engaged in an active learning process as partners. As a consequence, learning spaces should support engagement through easy facilitation of activities like team-based collaboration, idea generation, brainstorming, problem exploration and decision making, and artefact generation that extends beyond simply text and image creation.

To be able to facilitate such a broad range of activities, spaces should be agile enough to support a range of current and emerging pedagogies that span a range of related domains: from academically directed to student led learning; from individual to team based learning; and from theoretical analysis and critique to authentic and work integrated learning. Space design (and associated support activities like timetabling) needs to accommodate learning modalities that extend beyond the dominant lecture/tutorial model to models that emphasise a precinct-type approach to space utilisation, supporting access to a range of related spaces in varying time modalities.



Spaces should utilise appropriate elements like colour and artworks to encourage creativity and a sense of excitement as well as stimulate and challenge learners. Student feedback regularly indicates how much they notice the aesthetics of spaces.

**Principle 2: Spaces should provide a quality experience for users**

*Keywords: usable, comfortable, bright, spacious, attractive, fun*

Learning environments should actively promote learning excellence. Spaces should be inviting and welcoming with comfortable furnishings. Spaces should have plenty of natural and variable light, good ventilation and good quality acoustic treatment.

The design of learning spaces should include consideration of student access to comfort elements including food and beverage. Students are increasingly involved in learning activities that take place over long periods of time or occur in the evenings and on weekends. For this reason it is important to recognise their need to access adequate sustenance to ensure they have the mental capacity to continue their engagement with the learning activity underway. While this can be met in part by on campus cafes and restaurants, access to these resources outside normal hours also needs to be considered.

For similar reasons, the location of learning spaces also needs to give due consideration to safe and easy access to bathrooms, parent rooms and relevant student and staff support resources. With learning spaces now being used for longer hours and in more intensive modes, access to these sorts of comfort facilities is increasingly important to the student experience.

## Empowerment

**Principle 3: Spaces should help foster a sense of emotional and cultural safety**

*Keywords: welcoming, inclusive, nurturing, supportive, secure, positive, safe, motivating*

Learning needs to occur in an environment where learners are free from any concerns about their physical and emotional safety, where they feel welcome and included. Most universities articulate capabilities for their graduates that include social and ethical responsibility and an understanding of Indigenous and international perspectives. Learning spaces and university campuses that avoid all sense of cultural identity do not assist students in developing these capabilities.

In creating a safe and inclusive environment, it is important that learning environments still encourage learners to consider their role in the global community and aid the discovery and development of a broader sense of cultural awareness in students

A sense of physical safety is created for academic and student users of learning spaces through high levels of lighting and activity in and around learning spaces. Proximity to security services, the lack of obvious vandalism and graffiti, and the cleanliness of spaces and related services like bathrooms all contribute to creating a sense of safety.



**Principle 4: Spaces should enable easy access by everyone****Keywords:** *accessible, learnable, locatable, navigable, findable*

The location, design and configuration of learning spaces should be undertaken cognisant of the broad range of capabilities of potential users. This consideration should range from the more obvious requirements like ensuring that spaces can be adequately accessed and used by students with a range of disabilities through to more subtle requirements like making it easy for students to find a learning space and be able to successfully transition between relevant spaces within the timeframes that their timetable requires. The same principles apply to the technology utilised in learning spaces. The design, placement and control of systems need to accommodate a wide range of potential users.

**Ease of use****Principle 5: Spaces should emphasise simplicity of design****Keywords:** *functional, learnable, efficient, user-centred*

The intended use of a space, furniture or technology in a space should be self evident to users and/or require minimal specialist training to use. It is important that the design elements in any space are easy to identify and use as intended. This can be assisted by having familiar look-and-feel approaches to room design, common standards for information technology and audio visual systems, and simple and clear signage that indicates the role and purpose of any additional classroom element so that they can be utilised safely and with confidence. Support services should exist that can respond rapidly to problems in learning spaces to avoid major interruption to any learning activity, something which can be difficult given the extended time in which learning spaces are now in use on university campuses.

Modern learning spaces often incorporate such an extensive array of information technology and audio visual solutions that many users often feel overwhelmed. The technology systems in any learning space must be simple to use, reliable and supportable by technical personnel so that problems do not distract students or academics from the task at hand. The technology in learning spaces should accommodate a wide range of literacy levels in users (ie it should be easy for a novice user to learn and for an experienced user to utilise its advanced functionality). Care should be taken to introduce applications and control systems that echo interfaces that may already be familiar to users. Simplicity can also be a product of making conscious choices about what elements not to include in the design of a learning space.

**Principle 6: Spaces should integrate seamlessly with other physical and virtual spaces****Keywords:** *blended, ubiquitous, temporal, social, connected*

Learning spaces need to make it easy for students to connect with the world beyond the classroom and easily bring relevant resources back to use as part of their learning activities. Many of the psychological principles of learning spaces promote the sense of students and academics being involved in an active community of learners. Strictly speaking, they belong not to a single community of learners but a number of often overlapping communities that draw in the broader university, their discipline and even the broader society.



Students need to move about a range of spaces in order to undertake different aspects of a single learning activity. It is important to ensure that learning spaces do not impede this movement or introduce elements that require distraction from the learning activity during the flow of activities. Technologies like wireless should be activated in all informal spaces like coffee shops, gardens and other outdoor areas as well as in formal learning spaces and where possible the infrastructure should allow seamless movement without the need to log off and log on each time a student moves. Simple technologies like mobile whiteboards or writeable surfaces should be utilised to allow students and student groups to break out of formal classrooms to engage in learning on the move.

The design of university campuses, buildings and learning spaces needs to support opportunities for accidental or serendipitous interaction between students and academics. Educational research suggests that considerable learning takes place informally and incidentally, beyond the explicitly designed activities of the classroom. Learning occurs in casual contacts with faculty, staff and peers in the broader context of university campus life.

## Confidence

### **Principle 7: Space should be fit for purpose, now and into the future**

*Keywords: sustainable, maintainable, robust, agile, cost effective*

Learning spaces need to be robust and fit for ongoing use. In order to support a focus on learning, most staff and students suggest that learning spaces and the technology in them needs to be available where and when they need them. Put simply, they just need to work. To enable this, fabric, furnishings and technology utilised in learning spaces should be durable and robust enough to support active use and possible reconfiguration over a period of time. Care should be taken when introducing elements into a learning space that introduce any undue maintenance burden or items that can be easily stolen or removed. The use of remote monitoring systems to monitor learning space technology can also support a more proactive approach to support and rapid response to faults.

In addition, learning space installation standards should be developed and adhered to allowing ongoing understanding of the maintenance requirements of complicated electrical, acoustic, audio visual, networking and computing installations. Similarly, the timetabling of learning spaces needs to adequately provide for suitable maintenance and refresh periods.



**Principle 8: Spaces should embed a range of appropriate, reliable and effective technologies**

**Keywords:** *reliable, appropriate, effective, extensible, social, mobile, trustworthy, responsive, current*

Technology in learning spaces should be designed to allow students to easily interact with classroom activities and with each other. Technology for technology's sake should be avoided and the focus turned to technology that enhances learning and supports the social and interactive nature of modern pedagogies. Technology should be available to: allow students to access existing resources and knowledge; generate new ideas; and capture classroom activities – allowing easy play-back and review at a later time. A combination of institution provisioned technology and applications and student provisioned technology and applications should be supported that encourage student communication, collaboration, brainstorming and decision making.

In an environment where technology is constantly changing, institutions cannot hope to ever supply all the solutions, systems and hardware that academics and students might want to use in their learning activities. As a result, it is important that those solutions that it does provide integrate well with the broader array of solutions and environments available. This means a conscious avoidance, where possible, of solutions that require a particular hardware platform or configuration, applications that require platform-specific client software or specific browsers, and infrastructure elements that restrict academics and students from utilising appropriate solutions provisioned outside the institution. While complex, this ambition becomes progressively more critical when we observe the increasing array of laptops, netbooks, smart phones, and other mobile devices regularly being used by a broad spectrum of students.

The refinement of these principles benefited greatly from the input not only of those who attended the one day colloquium but also from a range of external contributors who willingly gave of their time.

## **Phase 2: Redevelopment of selected case study sites**

In an effort to both demonstrate and further develop the design principles developed above, each institution committed to the development of a trial learning space. It was expected that each of these case studies would involve the following steps:

- Step 1:** Formal analysis of key stakeholder experiences and perspectives.
- Step 2:** Planning the redevelopment based on principles developed.
- Step 3:** Physical redevelopment of learning spaces.
- Step 4:** Post-occupancy evaluation of spaces based on principles developed.
- Step 5:** Consideration of implications for redeveloped spaces for academic staff development, support services, facilities managers and architects.



## Queensland University of Technology redevelopment

The redeveloped space at QUT involved five central classrooms and the connecting corridor in a building originally built in 1970. The rooms had been described by some academics as “the worst in the university”. The aim for the project was to develop more flexible spaces where students can easily interact with academics and with each other. To this end, all rooms were improved with new and more comfortable ergonomic chairs, new colour schemes, additional writing surfaces, and upgraded projection facilities. However, rather than adopting a one-size-fits-all approach, each of the rooms was redeveloped in a slightly different way, with slightly different furnishings and technology based on size, orientation and intended usage.

Two rooms were simply upgraded with more mobile tables and privacy screens that would allow the rooms to easily move from individual to group-based learning activities. Two adjacent rooms were redeveloped with flexible tables that could be easily reconfigured into a range of different shapes; storage facilities; and a new acoustically sound glass dividing wall allowing the spaces to transition from individual work to small and large group activities easily.

The final room was redeveloped with a view to creating a team-based or problem-based learning environment. Renovations included the removing an old audio-visual projection box to create more space; removing the tiered flooring; recarpeting; refurnishing with new tear-drop-shaped tables; and supporting each table with its own mobile LCD screen. Technology in the room allows students to use their own laptops to interact with the large LCD screens and consequently with the central projection screen.

A key element of this redevelopment was the attention given to the central corridor as a means of connecting learning spaces rather than as simple a means of student access to the classrooms. By creating small break out spaces with comfortable benches and supporting them with writing surfaces in the form of glass boards and technology in the form of large LCD screens, the corridor itself became an active learning space.

While the redeveloped spaces contain many of the features and facilities found in other redeveloped learning spaces, the real success of the project is their implementation within the normal maintenance budgets for room redevelopment and technology refresh at QUT.

Student feedback suggests that the new spaces have been well received and appreciated:

*I love the new comfortable chairs.*

*The screens in the corridor are cool. It means me and my team can get together to discuss stuff before we go to class.*

*It's great to see more colour, the grey walls are a bit depressing. I like the fact that the space feels more alive. We should have more of them.*

As a recently refurbished space already previously timetabled, the observed level of new and more active types of learning is minimal. However, feedback from



academics keen to utilise the space for more active forms of learning suggests that the space responds well to an unmet need:

*The redevelopment takes the space from being one of the worst in the university to one where it's in such demand that I can't get as many classes in there as I would like. Another interesting outcome of the project is the observed increase in demand for the space outside formal teaching periods for conferences, workshops and other professional forums. It has been suggested that the precinct approach adopted in the space redevelopment better allows the space to support formal sessions, informal sessions, workshop registration points, poster displays and even social events.*

Overall, this space redevelopment clearly demonstrates that it is possible to retrofit a series of disconnected class rooms in a cost-effective manner to develop a learning precinct of formal and informal spaces that better supports more collaborative and active forms of learning.

### **Charles Darwin University redevelopment**

Charles Darwin University redeveloped an old general-purpose computer teaching space into a 50-person general-purpose, flexible wireless lab for IT, architecture and engineering students. This room was originally a centrally timetabled, rarely used, small, flat lecture space on a floor containing the university computer labs. It had only basic facilities – chairs, desks and whiteboards – with no technology available in the room.

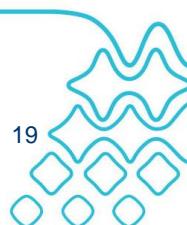
This room and an adjoining room were partially redeveloped in 2007 to create a large open space to teach 50 students in collaborative mode using the existing furniture, with the addition of wireless connectivity, 50 tablet PCs and data projection facilities. The refurbishment also included a storage space for the laptops.

In 2009, \$35,000 became available to update the furniture and fittings in the space. This enabled the collaborative, technology-enabled pedagogies designed to be used in this space to be fully realised. An interactive whiteboard was added to the space along with mobile co-operative workstations for students to use with their laptops. Easily movable chairs and furniture were added with an informal break-out space included in the room along with tea and coffee facilities. The room was repainted in bright colours with new blinds added. A glass board creates a fully writeable wall to increase the ambience of the space. The end result is a room that can be quickly adapted to a range of teaching needs with a range of supporting technologies for both staff and students.

Evidence from post-occupancy evaluations suggests that the redeveloped space both engages and empowers students and academics in the way intended by the design principles. Student feedback suggests that this cost effective redevelopment makes the space a more comfortable and interactive space in which to learn.

*The table layout is excellent for group work it helps to promote [collaboration].*

*The whiteboards allowed my classmates to learn together. Each group was given a whiteboard and able to write down what we learned and share with the class.*



*I loved the tea/coffee facilities. That makes me come to class more. It's relaxing, and so is the purple chair space.*

Academic staff feedback also suggests that the space is a better supports their desired learning activities than more traditional spaces:

*The thing is I really think the room allows you to develop a space for collaborative learning, and I suppose active learning as well, you can shift the desks around, you've got the technology in front of you, you can do a lot of things that in an ordinary room you can't do.*

Overall, this space redevelopment demonstrates how cost effective improvements, even to a single room, can make a marked improvement in student learning.

### **Edith Cowan University redevelopment**

Unfortunately, the intended redevelopment of a collaborative learning space in an old library building at the Joondalup campus was put on hold and not completed during the project due to changing university priorities regarding learning space redevelopment requirements.

A detailed overview of the all the space redevelopments can be found on the project website at: <http://learnline.cdu.edu.au/retrofittingunispaces/casestudies/intro.html>

### **Phase 3: Development of website and online repositories**

The final phase of the project involved finalising many of the project reports and bringing together the various resource collections either directly via the project website or through purpose-built online repositories. The actual resources contained in the project website have already been discussed in some detail in the project outcomes section of this report.

### **Advancing existing knowledge**

The project advances existing knowledge on two fronts: theoretical and practical. On the theoretical front, the learning space design principles literature review provides a useful overview of current thinking associated with learning space design. The structured way it arrives at its derived learning space design principles provides a comprehensive set of principles that covers most aspects of learning space design in a level of detail beyond most previous literature.

Secondly, the analysis of student, academic, and professional and support staff perspectives provides an insight into which design principles these stakeholders believe should be given more priority. It offers clear evidence that student attitudes to learning spaces extends beyond the four walls of the classroom. It also provides some evidence that the often-cited gulf between academic views and those of professional and support staff may not be as significant as originally suggested. For both the academics and professional and support staff priority was given to the need to develop spaces to support learning and the need to develop flexible spaces that respond to changing demands. There was also evidence that these groups have shared interests in comfortable spaces, engaging spaces, wireless and technology provisioned spaces, spaces that support student interaction and spaces that provide easy access to human comforts like coffee. Most interestingly of all, the difference between academic views and those of university professional and support staff are no different than the difference between academic views and student views.



Thirdly, the project extends the PST model developed by a previous ALTC-funded project (Radcliffe, Wilson et al. 2009), adding the ‘people dimension’ and mapping it to another useful framework in the area of usability (Kreitzberg 2008) thus providing a new model for learning space design principles. It is hoped that the new model presented by the project is both simple enough to understand and at the same time sophisticated enough to allow learning spaces to be designed and evaluated in a meaningful way.

On a practical front, the project outcomes have resonated with many of those connected with it in terms of the compelling evidence that the successful redevelopment of existing university learning spaces can be achieved in cost-effective and sustainable ways. The development of the multimedia presentation that provides a detailed look at each of the case study redevelopments has proved to be popular both for people who have been involved in the project and for people visiting the redeveloped spaces at both QUT and CDU. The collection of design plans and explanations; imagery and videos; and details about where various design elements can be cost effectively acquired seems to meet a previously unmet demand.

The final and perhaps most important contribution of the project was to highlight areas in need of future attention. One area specifically identified at each of the participating institutions was the need to bring greater focus to the development of academic staff capabilities. There is a need for more than just training academics to use new spaces and technologies. There is a need to develop both their capability and confidence in terms of being able to consider what might be possible when all the opportunities of the people, pedagogy, place and technology framework are realised. For each of the participating institutions, this means that the main work of the project is really just beginning. For instance, at QUT the project was a significant precursor to a multi-year program currently being developed to look at all aspects of developing staff capabilities in using modern learning environments – both physical and virtual.

## Critical success factors

A number of factors came together to contribute to the success of the project. At the project level these included:

- Participants who were actively engaged in the issue of learning space development.
- Having participants who were both actively engaged, and passionate about, developing cost effective and sustainable solutions for retrofitting existing learning spaces was a critical success factor to the project. Passion and commitment to the project goals was important to team motivation and ensuring that the project moved forward even when faced with challenges.

- Supportive project sponsors who were committed to project outcomes.
- Project sponsors who were strongly supportive of the goals and outcomes of the project were another critical success factor for the project. Committed sponsors helped ensure that adequate resources, time and priority could be given to achieving project outcomes. Committed sponsors will also be critical to the ongoing success of the project by ensuring that project outcomes are incorporated into ongoing plans for the partner universities, rather than simply archived once completed.



- The development of a mutual trust among project team members.

Developing mutual trust among team members was critical for two reasons. Firstly, it provided a platform for willingly sharing ideas and positively receiving criticisms among the project team. This was critical to the development of the final set of learning space design principles. Secondly, it was essential to ensuring commitment by university senior managers to taking well considered risks in the case study redevelopments. Both redevelopment cases introduced elements outside each university's standards for learning spaces and, as such, trust was a critical precursor to both general acceptance of new ideas and fair assessment post implementation.

### **Impeding factors**

The project faced one significant challenge in the area of changing development priorities. Managing learning space projects that involve the actual redevelopment of learning spaces presents considerable potential risk in changing times. Commitments to the redevelopment of space are not insignificant in both time and resources and are also closely interlinked with strategic priorities across the university. Changes in these priorities can have significant impacts on project outcomes as was the case in this project with the loss of one case study redevelopment. While not detracting from the overall success of the project, it does impact the richness of the data that could have been obtained.

### **Implementing project outcomes**

Within each of the partner institutions, project outcomes are already having a significant impact on ongoing learning space design projects.

- The redevelopment of new spaces at QUT in the science and technology and built environment and engineering buildings have incorporated learning precinct ideas developed during the project including break-out-spaces and flexible furnishings.
- At CDU, the design and development of the new Australian Centre for Indigenous Knowledge and Education incorporates formal and informal spaces with ready access to tea and coffee facilities all supported by mobile technologies.
- Redevelopment of spaces within the Edith Cowan University library allows for a range of learning activities, from active groups to more individual and reflective.
- The designs for a new Science and Technology Precinct at QUT include the use of mobile technology developed during the project.

In addition to the specific impact on these explicit learning space projects, project team members have all reported finding increased opportunities to participate in learning space design activities at both their own and other institutions.



Beyond the immediate reach of the partner institutions, the commonly held need for cost effective solutions to learning space redesign has seen project outcomes positively received. Project leaders have been involved in the provision of advice to a range to other Australian and overseas universities including institutions in New Zealand, Singapore, Hong Kong, Canada and the United States. Feedback received at an international conference indicates that the project outcomes resonate even in places where the costs of learning space redesign have not traditionally been an issue.

*Very entertaining and informative. Love to see ideas that are 'out of the box'.*

*This session is why I attend this conference.*

*Made me want to enrol just to experience their approach to true collaborative learning and facilitation of material. I really look forward to seeing how they move what they've learned in informal spaces into what are considered more traditional environments.*

In addition to advising the university sector, the project has attracted considerable interest from the private and public school sectors, no doubt driven in part by current government funding initiatives.



## Dissemination

In addition to the one-day colloquium and local presentations at each of the participating institutions, outcomes from the project formed all, or part of, a number of papers, conference presentations and workshops both nationally and internationally.

### Conferences – unpublished workshop

Mitchell, G., Howell, G., & White, B. (2009). Retrofitting University Learning Spaces: From Teaching Spaces to Learning Spaces. ASCILITE Conference, Auckland, New Zealand.

### Conferences – refereed proceedings

Mitchell, G., Matthews, G., Pospisil, R., & White, B. (2009). Space Matters – Particularly when you don't have a lot, HERDSA Conference, Darwin, Australia, July, 2009.

### Conferences – unpublished presentation

Mitchell, G. & Howell, G. (2009). Why Flexibility is the Key Design Criteria for New Learning Environments, EDUCAUSE Australasia, Perth, Australia.

Milne, A. & Mitchell, G. (2009). Smarter, Cheaper, More Effective: New Models for Learning Space Design, Campus Technology 2009, Boston, MA.

### Invited presentations

Mitchell, G. (2009). Queensland University of Technology: Developing Effective Learning Spaces, ACODE Workshop, The University of Queensland, Brisbane, July, 2009.

Partridge, H. (2010). Retrofitting Learning Spaces, Presentation to Australian Council of Deans of ICT Learning and Teaching Network Forum, Sydney, 5–6 July 2010.

Stokker, J. (2009). Student Perceptions of Learning Spaces, Queensland University Libraries Office of Cooperation University Librarians Forum 2009, Brisbane, 26 November 2009.

White, B. (2010). Teaching in Technology Rich Classrooms, Australian Catholic University, Melbourne, 28 July 2010.

In addition to these publications and presentations, the results of the project have been informally disseminated through professional organisations like the Council of Australian University Directors of Information Technology (CAUDIT), the Council of Australian University Librarians (CAUL), and Tertiary Education Facilities Management Association (TEFMA).

All project resources are available on the project website  
<http://learnline.cdu.edu.au/retrofittingunispaces/index.html>



## Linkages

During the project, many formal and informal linkages were developed by the project and key project team members. Nationally informal linkages have been made with a number of architectural firms and furniture manufacturers. Internationally, informal linkages have been made with a number of key technology providers.

Emerging linkages are being developed with US universities in Minnesota and California who are interested in the joint investigation of the effectiveness of collaborative and peer-based learning spaces. These linkages will be important elements in any new project to look at expanding academic staff capabilities.

### Linkages with strategic priority areas

The project has developed linkages with other ALTC learning spaces projects, most notably the 'A comprehensive learning space evaluation model' (2008) project involving Nicolette Lee (Swinburne University of Technology), Julie Dixon (Victoria University), and Trish Andrews (The University of Queensland). A presentation on the implication of project outcomes for new evaluation strategies was included as a keynote at this project's two-day colloquium held in September 2010.

### Linkages with disciplinary and interdisciplinary areas

The outcomes of the project, while relevant to almost all discipline areas, has found considerable traction in the science, technology, built environment and engineering disciplines. Specific activities at both QUT and CDU have emerged with these disciplines in terms of developing programs to help engage academics in these disciplines with the affordance offered by these new spaces. Moves within these disciplines towards greater levels of problem based, collaborative and peer supported learning converge nicely with the design principles behind the project.

Longer-term activities designed to address not only issues of academic capability but also to fundamentally explore the design of curriculum in these disciplines will have interesting and compelling implications for the design of learning environments.



## Conclusions

Overall the project has been successful in demonstrating ways to redevelop existing university spaces to facilitate new styles of learning in a cost-effective manner. The project outcomes provide both a theoretical base for learning space redevelopment and practical guidance to achieving effective outcomes.



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