

ADVANCES IN LEARNING ENVIRONMENTS RESEARCH

# Evaluating Learning Environments

***Snapshots of Emerging Issues, Methods and Knowledge***

Wesley Imms, Benjamin Cleveland and  
Kenn Fisher (Eds.)



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# **Evaluating Learning Environments**

# ADVANCES IN LEARNING ENVIRONMENTS RESEARCH

Volume 8

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## *Scope*

The historical beginnings of the field of learning environments go back approximately 40 years. A milestone in the development of this field was the establishment in 1984 of the American Educational Research Association (AERA) Special Interest Group (SIG) on Learning Environments, which continues to thrive today as one of AERA's most international and successful SIGs. A second milestone in the learning environments field was the birth in 1998 of *Learning Environments Research: An International Journal* (LER), which fills an important and unique niche.

The next logical step in the evolution of the field of learning environments is the initiation of this book series, *Advances in Learning Environments Research*, to complement the work of the AERA SIG and LER. This book series provides a forum for the publication of book-length manuscripts that enable topics to be covered at a depth and breadth not permitted within the scope of either a conference paper or a journal article.

The *Advances in Learning Environments Research* series is intended to be broad, covering either authored books or edited volumes, and either original research reports or reviews of bodies of past research. A diversity of theoretical frameworks and research methods, including use of multimethods, is encouraged. In addition to school and university learning environments, the scope of this book series encompasses lifelong learning environments, information technology learning environments, and various out-of-school 'informal' learning environments (museums, environmental centres, etc.).

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*Snapshots of Emerging Issues, Methods and Knowledge*

*Edited by*

**Wesley Imms, Benjamin Cleveland and Kenn Fisher**

*University of Melbourne, Australia*



SENSE PUBLISHERS  
ROTTERDAM/BOSTON/TAIPEI



A C.I.P. record for this book is available from the Library of Congress.

ISBN: 978-94-6300-535-7 (paperback)

ISBN: 978-94-6300-536-4 (hardback)

ISBN: 978-94-6300-537-1 (e-book)

Published by: Sense Publishers,  
P.O. Box 21858,  
3001 AW Rotterdam,  
The Netherlands  
<https://www.sensepublishers.com/>

All chapters in this book have undergone peer review.

Cover image: Enterprise Centre, Camberwell High School, Victoria, Australia.  
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## **ACKNOWLEDGMENTS**

The publication of this book was supported by the Australian Research Council's Linkage Project scheme (LP130100880 Evaluating 21st Century Learning Environments). The views expressed herein are those of the authors and not necessarily those of the Australian Research Council. The E21LE project would like to express its gratitude to Ms Heather Mitcheltree for her extensive work in the development of this book, and to the project's research partners, Hayball, Keepad Interactive, Anglican Church Grammar School, Australian Science and Maths School (ASMS), Caulfield Grammar School, and Rubida Research.



## INTRODUCTION



*Camberwell High School  
Photo courtesy of Hayball Architecture  
Photo credit: Dianna Snape*

## 1. PURSUING THAT ELUSIVE EVIDENCE ABOUT WHAT WORKS IN LEARNING ENVIRONMENT DESIGN

It is an exciting time to be involved in education. Every day we witness the pursuit of innovation and creativity in schools, the sophisticated development of personalized learning approaches, the increasing usefulness of ubiquitous technology, and the excitement surrounding the many ways education can contribute to burgeoning ‘knowledge economies’. These ‘new age’ priorities are combining to enable students to increasingly take responsibility for their own learning and are encouraging teachers to become the curators of learning experiences, that range from whole class didactic encounters, through collaborative peer-peer active learning to reflective one-on-one consultations with students – often within a single lesson.

To meet this change, schools are altering their architecture and spatial arrangements, sometimes quite dramatically. Through discussions between designers and teachers about how learning and teaching should be approached in the 21st century, the traditional corridor and classroom layout is increasingly being reconfigured into ‘flexible’ school designs. Differing in important ways from the 1970s open classroom and ‘free-range learning’ concept, the best of these spaces can theoretically accommodate a variety of teacher epistemologies and a range of students’ preferred learning styles.

A formidable variety of spatial typologies are now emerging. Dovey and Fisher (2014) summarise these into five genres of design (Figure 1), ranging from the traditional egg-crate style, through to large open space configurations. As represented in the diagram, ‘openness’ increases from left-to-right across the typologies, with the experienced educator often commenting that maximum flexibility occurs in types C and D, where walls, doors, furniture and spaces can be (re)configured to support a wide array of desired learning and teaching practices, activities and behaviours.

Dovey and Fisher (2014) importantly note that while their typologies describe design trends, they can be better understood as *assemblages*, where iterative practices mix with adaptive space configurations to create a hybrid of space and pedagogy unique to each educative occasion.



Figure 1. Dovey and Fisher's learning space typologies (2014), adapted by Soccio & Cleveland, 2015

Thus, a well-designed open area, such as shown in Figure 2, can simultaneously be a lecture theatre, a setting for small group meetings, a place for visible teaching and learning for staff and students on the periphery (Hattie, 2011), and a learning zone for those transiting between experiences.



Figure 2. Yarra Valley Grammar School – Science and Mathematics Building, Hayball with Engaging Spaces. Photo copyright Dianna Snape (used with permission)



Likewise a space can be inhabited by students (Figure 3), a type of colonization where the most important output is the collaborative, democratic synthesis of ideas and knowledge not unlike the ideal described by Dewey (1916/1997) a hundred years ago.



*Figure 3. Coatesville Primary School, Clarke Hopkins Clarke Architects  
(used with permission)*

Such spatial developments are disruptive interventions that often displace, rather than replace, the teacher. By displacement, we mean that in such socio-spatial settings, the teacher is removed from being the focus of attention with students seeking out the educator they feel owns the specialised knowledge that will best inform their learning issue. While didactic instruction remains a necessary pedagogy, increasingly spaces in schools are being designed and used to allow students to work with a range of knowledgeable others to socially construct knowledge and meaning. As illustrated in Figure 4, students can work in isolation or in small groups. They can use fellow students for peer instruction, undertake independent work in a collegial environment, and utilise the capacity for movement within the space to seek out those who can best inform a learning issue. Rather than removing the teacher, such spaces are designed to elevate them to the role of expert collaborator.

Such scenarios describe an idealized educational world. The figures shown above are staged for the photographs to illustrate how a space is *intended* to be used. And while these photos depict a static situation, frozen in time, they hide the temporal issue which is another facet to be considered in innovative learning environments – when is didactic teaching required, when reflective, when peer-peer-based, when maker-space, when studio/workshop/lab/outdoor learning? Can the spaces adapt to these requirements?

The question remains, when looking at photos such as these, what is the reality? Are the typologies described by Dovey and Fisher (2014) being used in the democratic and differentiated manner described by Dewey (1916/1997) and others? If they are, the logical question is what is their effect? (Hattie, 2008); do they improve teaching and learning standards to the degree where their cost and use is warranted?



Figure 4. Catholic College Wodonga – Mercy Senior Learning Centre, No. 42 Architects with Engaging Spaces (used with permission)

As shown in the figures above, what may be termed new generation learning environments (NGLEs) are characterised by polycentric room designs, infused information and communication technologies, flexibility brought about by moveable walls and other agile interior elements, a variety of ‘student friendly’ furniture, and ready access to resources. They significantly expand our conceptualisation of the learning and teaching space, but bring with them a perplexing problem: what methodologies are ‘best fits’ for evaluating such environments? The following chapters in *Snapshots* explore the complex issue of how we evaluate the impact of learning environments. In particular they problematize the issue of how we measure the impact of NGLE’s on student learning, teacher pedagogy, and associated variables. Indeed Dovey and Fisher (2014) have called these NGLE’s *complex adaptive assemblages*, to illustrate the difficulty of evaluating such innovative spaces.

*Snapshots* constitutes new knowledge that will assist teachers to utilise these spaces effectively. Although the re-conceptualising and inhabiting of new school

architecture is moving at an unprecedented pace, teachers' abilities to utilise new spaces are not always matching this growth. An analysis of literature reviews (Cleveland & Fisher, 2014) identifies a general acceptance that many teachers have poor 'environmental competence', thus limited capacity know how to "... understand and effectively use physical instructional space for a pedagogical advantage" (Lackney, 2008). Increasingly, teachers are being challenged to re-think how they teach in order to maximise the instructional use of new learning environments. This raises the notion of teacher *spatial literacy*, which is not to be confused with visual literacy. Spatial literacy, which works in the 3rd dimension and indeed the fourth dimension – the temporal – is also critical to these NGLE's (New London Group, 1996).

Using NGLEs effectively requires a significant evidence base to assist teachers to reconceptualise space as a pedagogic tool (Cleveland, 2011). In addition, new designs are being put into place with scant evidence that the resulting expense and disruption to teaching practice is underpinned by evidence that the designs 'work'. Even a brief review of research from the 'open classroom' era in the 1970s (Imms, 2016) shows that little robust evidence was collected concerning the impact of those spaces on student learning. Without such research, education is doomed to repeat errors of the past. What is required, and quickly, is a robust approach to evaluating the impact of NGLEs. *Snapshots* is a significant move in that direction.

#### LINKING EVALUATION THEORIES TO LEARNING ENVIRONMENT CONTEXTS

The *Evaluating 21st Century Learning Environments* (E21LE) Australian Research Council (ARC) Linkage Project was set up to conceptualise, develop and trial innovative approaches to the evaluation of physical learning environments in today's secondary schools. Sponsored by the Australian Federal Government and situated within the Learning Environments Applied Research Network (LEaRN) at the University of Melbourne, the project brought together five industry and educational Partner Organisations to tackle the elusive goal of determining 'what works' in learning environment design. The Partners of the project are indicative of the multi-disciplinary nature of the issue being addressed. An architectural firm (Hayball) and a technology supplier (Keepad Interactive) have formed an alliance with three Australian schools – the Australian Science and Mathematics School in Adelaide, South Australia; the Anglican Church Grammar School in Brisbane, Queensland; and Caulfield Grammar School in Melbourne, Victoria. Led by a team of academics from the University's Melbourne Graduate School of Education and Faculty of Architecture, Building and Planning, and incorporating three PhD candidates (two from Education, one from Architecture) this uniquely multi-disciplinary team is bringing an array of specialist knowledge to this issue.

E21LE is not an evaluation *per se*. Its purpose is to develop a robust evaluation framework that will allow education and design professionals to assess a variety of design and educational variables across a variety of sites for a variety of purposes.

The driving philosophy is that a learning environment evaluation framework must be many things to many people. If one common purpose can be described, it would be to facilitate the collection of rigorous, useable evidence concerning the impact of spatial design on pedagogy and learning. E21LE is conceptualising, developing and trialling this framework through a variety of primary and secondary research methods.

The project is not looking for a single definition or model of evaluation that will direct its practices. Rather, it seeks to map an evaluation ‘terrain’ that logically links its acts of evaluation to learning space phenomenon (Imms, Cleveland, Mitcheltree, & Fisher, 2015). E21LE’s protagonists acknowledge that the research must work within a frame of reference that is meaningful and coherent across the whole education/design landscape. Such an ambiguous foundation is not uncommon. Love (2010) argues that a single approach to evaluation is not often possible and that evaluation is mostly an applied activity that takes place in real-world settings. Likewise, Carden and Alkin’s (2012) analysis of evaluation theory recognises that a characteristic of evaluation practice is the making of concessions. Evaluators commonly encounter multiple and competing purposes for evaluation, numerous stakeholders with contradictory needs, limited time and budget for evaluation, and conflicting views about evaluation methodology. A single methodology or method is, under these circumstances, not practical.

The issue of multiple and competing complexities in evaluation is especially pertinent to E21LE. The project is deliberately multi-disciplinary, trying to integrate the sometimes contradictory epistemologies that underpin architecture and education. These disciplines each have their own rich tradition of evaluation, but there are few models that bring these fields together in a consistent and coherent manner. E21LE also spans the infamous research ‘paradigm divide’ – qualitative vs. quantitative methods – with both seen as being equally useable within the scope of the research questions being posed by this project.

Finally, the research is further complicated by the need to address multiple audiences and supply findings that have applications in architecture, education and public policy. It is clear that the ways in which E21LE defines and then utilises evaluation has *theoretical*, *methodological* and *application/audience* perspectives. As such, it is logical to organise this book around an aligned three-part framework: *emerging issues*, *emerging methodologies*, and *emerging knowledge*. This will be described presently.

#### A NOTE ON EVALUATION THEORY

Evaluation theories define a project’s guiding principles, as compared to its actual practices. These principles define the body of knowledge that ‘...organises, categorises, describes, predicts, explains, and otherwise aids in understanding and controlling...’ the focus of that evaluation (Shadish, Cook, & Leviton, 1991). Theory allows researchers to decide and justify the ‘where, when and why’ of the application of evaluation methods.

To this degree, the role of theory within evaluation is clear and logical. However, as a relatively new and rapidly developing discipline there exists no common agreement regarding the nature of evaluation's actual structure. For example, theories can be *prescriptive* by stipulating the rules and frameworks that control evaluation; or they can be *descriptive*, providing explanations and statements that generalise possible approaches. Theories can be based within a *realistic* epistemology (Pawson & Tilley, 1997) where it is argued that the agents that dictate outcomes must be the focus of the evaluation; or they can be *theory of change* oriented, where theories concentrate on the actual result and resultant claims of causation (Weiss, 1998). It is possible to have theories *of* evaluation that direct explain and justify an approach, and theories *for* evaluation which address issues of application of the evaluation's aims and outcomes (Astbury, 2012). These elementary distinctions regarding evaluation orientation are discussed later in this paper, where they inform E21LE's positioning of evaluation within its research context.

The question can be asked, 'Is there some logical schema to evaluation theory'? As methodological approaches to evaluation proliferated, Alkin and Christie (2004) sought to give the field some coherence. They developed a 'roots' taxonomy that argued all evaluation methods were logically linked to two core evaluation functions: *accountability & control*, and *social inquiry* (a third was added in 2012: *epistemologies*). They argue that (1) accountability meets a community need to justify investment and ensure future program quality, and (2) social inquiry provides robust methods of systematic evaluation. While the accountability function focuses on *rationales* for evaluation, the social inquiry function focuses on *applications* of evaluation.

Three practices of evaluation have grown from these two foundations: those of *use*, *methods*, and *valuing*. Evaluations with a 'use' practice grew from an accountability foundation and are those focused on the further application of the knowledge gained, as characterised by the theories of Stufflebeam (1983). Evaluations with a 'methods' practice are those that adhere to prescribed research methodologies in order to provide robust findings, characterised by the theories of Campbell (1957). Evaluations with a 'value' practice are those that recognise the role of human judgement in evaluation, characterised by the theories of Scriven (1967). Within this latter category, an 'objectivist' sub-branch limits valuing to being the informed view of the evaluator, while a 'subjectivist' sub-branch recognises the phenomenological nature of evaluation, drawing on the opinions and interpretations of participants. Both the 'method' and 'value' practices had their origins in the social inquiry foundation.

Alkin and Christie (2004) argued that the roots metaphor supported a logical theory 'flow' that applied to all evaluation methods in practice. They argued that such methods could be traced through practices of evaluation (the branches) directly to evaluation's foundational roots. A later paper by Carden and Alkin (2012) added a third foundation of *epistemologies*. They argued the robustness of this taxonomy, stressing that the theoretical 'flow' was not exclusionary, rather that particular

orientations merely reflect the ‘primary emphasis’ of the evaluator, while accepting methodological and theoretical concessions necessary in any evaluation.

In other words, while theorists can identify specific genres of evaluation, these must be recognised as flexible and adaptive when *in practice*. Practice, though, must remain accountable to the predominant theory that informs it. These two components of evaluation – theory and practice – are interdependent. ‘Best practice’ in evaluation cannot be developed separate from the theories that inform that practice. As outlined by Chelimsky (2013, p. 91), “each one learns from the other and, in that learning process, both are inspired to stretch, to bend a little, and to grow”.

The third element in the evaluation process is *applicability*. While designing an evaluation – and subsequently gathering of data to provide an evaluative analysis – are both critical so, too is how those data are used. Results must serve a purpose and these purposes reflect political functions and social implications. Chelimsky (2013) put it thus:

... the evaluations we produce, that are based on theory and performed in the real world, are also planned, implemented, analyzed, and reported by people. And those evaluations are open, from beginning to end, to political pressures by policy makers, planners, administrators, special interest groups, subject-area practitioners, participants, and all those who may be affected by the results—or feared results—of the evaluation. (p. 92)

Therefore, with this somewhat ephemeral mixture of theory and practice, evaluation must be approached with caution.

#### SITUATING THEORIES OF EVALUATION WITHIN E21LE

What then are the implications of this brief summary for *Snapshots*? In short, it provides a structure for an evaluative framework suitable for the complex phenomenon of innovative learning environments. Thus, these chapters are seen as contributors to the population of that matrix. To explain further, the general purpose of evaluation is to establish *merit*, in its widest societal sense determining anything from the best restaurant or seats at a football game, to informing major government decisions. While approaches to evaluation may vary widely within research, Weiss (1998) claims that all contain five common elements. Evaluation research provides; rigor, through being *systematic*; it focuses on *process* and *outcomes*; it is *comparative*, using established goals against actual outcomes; and it has *purpose* in that it seeks to improve practice. Thus, while evaluation research involves establishing the merit of social initiatives, *its purpose is improvement of future practice*.

Weiss’ summary of the purpose of evaluation mirrors the traditionalist approach evident in work done by historical figures such as Cooke, Campbell (in Shaddish et al., 1991), Pawson and Tilley (1997) and others. Through experimental and quasi-experimental evaluations of organizations and programs (see, also Scriven,



1967), evaluation aims to audit existing practices to improve society and generate new theory. Mark, Henry and Julnes (1999) describe this as a representational evaluation purpose. They go further to offer an additional purpose of evaluation, the valuative, where qualities people attribute to phenomena lead them to ‘natural’ assessments. Mark et al. characterize this as *assisted sensemaking*: the acknowledgement of humans’ pre-disposition to make judgments about their existence. The premise here is that the underlying purpose of evaluation is to help, rather than replace, that natural process. A useful way to bring these descriptions together is describing evaluation as serving the purpose of improving future practice by looking back (auditing/appraisal), looking to the future (improvement and prediction/analysis) and looking within (valuing/judgement).

This review of evaluation literature (see, for instance Shufflebeam and Shrinkfield, 2007) would indicate that evaluation research meets the needs of those who wish to *describe* (assess an observable attribute), those who wish to *classify* (assess underlying structures and categories), those who wish to identify *causality* (assess what outcomes can be attributed to a program), and – to add Mark et al. (1999) – those who wish to understand *values* (assess the experiential quality of a program).

As these needs are neither mutually exclusive nor irrevocably linked: the evaluation theories outlined above led the E21LE research team to the concept of an evaluation matrix. [Figure 5](#) represents the project’s approach to tailoring evaluative approaches to meet a variety of purposes and needs.

		Meeting the needs of those who wish...			
		To describe	To classify	To identify causality	To determine value
The purpose of evaluation research is...	(Aim)	(Through)			
	To improve	Formative analysis (judgment)			
	To audit	Summative analysis (appraisal)			
	To generate theory	Predictive analysis (analysis)			

Figure 5. E21LE matrix of evaluation research ‘purpose’ and ‘needs’ (after Mark, Henry, & Julnes, 1999)

## SITUATING EVALUATION METHODOLOGICALLY WITHIN E21LE

The matrix above (Figure 5) allows E21LE to position the myriad existing (and upcoming) learning environment evaluation tools in a way that allows those from education, design and other stakeholders to implement evaluation strategies attuned to their purposes and needs. This theoretically-based, methodologically flexible structure has the capacity to ‘house’ all perceivable evaluation devices desired by multi-disciplinary teams wishing to undertake complex evaluations of learning environments.

*Snapshots* is beginning the process of populating this matrix. Each chapter describes an approach to learning environment evaluation that serves a differing set of purposes and needs. For example, the three E21LE doctoral projects have three approaches – Oliver’s expert elicitation methodology (Chapter 8) serves an ‘auditing’ (appraisal) purpose through classification; Byer’s (Chapter 9) method serves an ‘improvement’ purpose through identifying causality (judgement); and Sala-Oviedo’s (Chapter 10) approach has a theory generation purpose (analysis) serving a strong values need. Without this type of structure, existing and upcoming evaluation tools run the risk of not meeting the complex needs and purposes evident in the sophisticated world of modern education and learning environment design.

## THE NEED FOR EVIDENCE ABOUT ‘WHAT WORKS’ IN LEARNING ENVIRONMENTS

It is sometimes asserted that if we had sufficient compelling evidence which argues that new generation learning environments are improving learning outcomes then there may be greater interest in transforming teaching practice, an approach occurring in the health sector where evidence-based design (EBD) has now reached a mature stage (EDAC, n.d.; HERD, n.d.). While the concept of translational research and evidence-based practice and design may be well-accepted in medicine, the models for transforming pedagogy in both school and tertiary-level teaching are still seen as much more contestable. Nevertheless, Hargreaves and Fullan (2013) argue that transforming teaching requires building professional capital, a process that is far more complex than data driven models of building business capital. Leadership for transformative change in teaching will be, they say, “a judicious mixture of push, pull, and nudge” (p. 39). The E21LE project hopes to influence the push, pull and nudge factors of pedagogical change through developing frameworks and strategies for evaluation that align practice and space.

There are two common purposes in educational evaluation, which at times are in conflict with one another. Educational institutions often require evaluation data to (1) demonstrate various forms of effectiveness to funders and other stakeholders, (2) provide a measure of performance for marketing purposes and (3) to inform evidence-based policy development. Evaluation in this context is also a professional activity that individual educators may undertake if they intend to review and



enhance the learning they are endeavouring to facilitate. Yet, the use of evaluation to drive transformative change in education is highly vexed, particularly in the higher education sector where universities value academic freedom and professional development is largely carried out through conferences and peer-to-peer networks. Any form of top-down organised transformation is hotly contested and indeed commonly resisted or corrupted. To a degree, this is true in schools as well, as teacher professional development is often left to the individual and there is often little compunction for teachers to change the way they practice.

Evaluations can be industry or academe lead. In the realm of evaluating learning environments this can promote evaluations that have a high orientation to objective/technical aspects (such as post occupancy evaluation in architecture) or those that have a high orientation to abstract/qualitative aspects (such as measures of learning outcomes in education). Certainly, previous approaches to post occupancy evaluations of learning spaces have been less concerned with pedagogy and more focussed on issues related to indoor environment quality, construction and building quality. Conversely, what is often evaluated within pedagogical practice is not only quite varied, but contested in terms of what practices are most highly valued, and rarely if ever do these evaluations cover the places and spaces for learning.

Cleveland and Fisher (2014) concluded that “approaches to evaluations that attempt to assess the effectiveness of physical learning environments in supporting pedagogical activities are in their infancy and require further development” (p. 26). They also concluded that research in this field “could profit from an interdisciplinary approach that involves people from a variety of backgrounds, including but not limited to education, human geography, environmental psychology and architecture” (p. 26).

Further to this, Lee and Tan (2011) highlighted that “while there has been much attention to the design of learning spaces over recent years, evaluations of learning spaces have been limited in depth, rigour and theoretical grounding, and heavily reliant on informal or anecdotal evidence” (p. 3). They emphasised that evaluations are highly contextual with a tendency for studies to describe outcomes positively.

The E21LE approach, developed and outlined in the pages of this book, recognises the existence of many effective evaluation strategies while also being aware of the field’s evident weakness in utilising these in ‘real world’ circumstances. Some significant learning environment evaluation work has been, and is currently being, undertaken at the OECDs CELE (OECD, 2016a). Over the past decade there has been significant pressure for this Centre (formerly known as the Programme on Educational Buildings) to develop stronger statistical outputs from its activities, in keeping with overall OECD educational indicators work (OECD, 2015). Most recently, CELE has collaborated with CERI (the Centre for Educational Research and Innovation) in the Innovative Learning Environments project in which numbers of case study schools were evaluated in a number of countries internationally (OECD, n.d.a.; OECD, n.d.b.). CELE is now embarking on an international evaluation study of school learning environments through the PISA (Australian Council for

Educational Research, 2015) survey portal in 2015 and is proposing to survey many thousands of students and teachers as to their views on their learning environments (OECD, 2016b). In part this is being managed by ACER in Melbourne (Australian Council for Educational Research, 2016). Another international approach to evaluations is being undertaken by Educause (Educause, 2016a). This organisation has established an evaluation pilot tool – Learning Spaces Rating System – which is currently being trialled before being fully launched (Educause, 2016b). It is an excellent attempt at codifying evaluation categories so that we can make better comparisons between the impact of various learning environments. This study is USA centred but it will be a significant tool to test in other countries. The issues are similar to those encountered in Building Research Establishment Environmental Assessment Methodology (BREEAM), Leadership in Energy and Environmental Design (LEED) and Greenstar tools in terms of each of those individual country's foci. The E21LE project is, in effect, a meta-synthesis of large and small evaluations presented in a structure that allows the widest array of clients to design, implement and access cutting edge evaluations. *Snapshots* provides a glimpse of this plethora of issues and approaches.

#### WHAT IS THE STRUCTURE OF *SNAPSHOTS*?

*Snapshots* is presented in three sections. Co-editor Imms introduces the *emerging issues* section, which serves the purpose of providing a glimpse of the broad range of topics that any useful evaluation matrix of learning environment evaluations must embrace. It illustrates the need, as presented in the structure of the E21LE matrix, to move beyond simplistic 'causality' evaluations into topics such as policy, teacher change, teaching practice and multi-sector evaluations, and provides a sense of the increasing complexity of this field. Next, co-editor Cleveland presents the section on *emerging methodologies*. This section illustrates the development of 'new' approaches to learning environment evaluations being developed, trialled and refined by some of our brightest minds. It illustrates how sophisticated the evaluation needs of 21<sup>st</sup> century education have become. Finally, co-editor Fisher introduces the third section, that of *emerging knowledge*. It is a tempting and challenging glimpse of the new information being generated as we speak. It serves to not only help us understand how quickly ideas are being turned into workable evaluation methods, it also highlights the significant gap that exists in the development of a significant scholarly body of knowledge as to how learning environments impact on learning outcomes.

The Chapters in this book we hope will contribute to the global works-in-progress which all aim to close this gap.

#### WHO CONTRIBUTES TO *SNAPSHOTS*?

In keeping with the multi-disciplinary problem of evaluating the design and pedagogic impact of NGLs, the chapters presented in this book come from authors

spanning a range of disciplines. Their bibliographies are presented at the conclusion of this book. These contributors are practicing architects, teachers from the tertiary sector through to primary schools, acousticians, environment space designers, and educational consultants. All have, however, two things in common. Each is a highly skilled and experienced practitioner in their own field, and each is a current, or a recently completed doctoral student undertaking research on this broad topic. Doctoral students are challenged to explore the ‘dark edges’ to a problem, and as such offer rigorous but ‘boundary-free’ thinking, facilitated by the mandate to push known knowledge to its limits. As such, no better team could undertake the work of conceptualising and trialling approaches to our new-age issue – how to evaluate the impact of the modern learning space.

#### ACKNOWLEDGEMENTS

The authors wish to acknowledge the significant contribution to sections of this chapter by Graeme Oliver, Ana Sala Oviedo, and Terry Byers.

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## EMERGING ISSUES



*Brighton Secondary College  
Photo courtesy of Hayball Architecture  
Photo credit: Dianna Snape*

WESLEY IMMS

## 2. NEW GENERATION LEARNING ENVIRONMENTS

*How Can We Find out If What Works Is Working?*

### INTRODUCTION

This book's introductory chapter discusses the rapidly growing academic conversation occurring around learning environment research. It highlights one significant gap in the literature in this field; the evaluation of such spaces. Its conclusion isn't that little research has been done to document impact, but what has been done has been too particular in focus and method, therefore being limited in its usefulness to practitioners.

This first section of *Snapshots* is concerned with such gaps, and uses emerging research for their identification. Doctoral students bring a fresh perspective to any academic discourse in tandem with knowledge gleaned from recent practices in the field. Their work, consistently serves the purpose of placing a spotlight on omissions within existing knowledge.

In terms of learning environment evaluation, these omissions, understandable as they are given the relative youth of this topic, nevertheless contribute to a disjointed knowledge base concerning the educational impact of learning spaces. It is a disjuncture that is characterised by a preference towards affective issues (how people are responding to such spaces) at the cost of attention to effective issues (what evidence exists to quantify this impact). While these domains address differing aims they are also logically connected. Paucity in one area creates a lack of understanding in the other.

This is not an indictment on past research, rather an acknowledgement of the scale of work yet to be done. The nature of this underdeveloped body of literature is the focus of the initial section of this book. The question to be addressed is what is required of learning environment evaluations; what key issues need to be explored in order to develop a comprehensive, 'catholic', *useable* learning environment evaluation strategy?

The chapters to follow within this section are snapshots of issues that assist in plugging perceived gaps. These insights come from our academic community's brightest minds; post-graduate researchers emerging from extensive experience in school and design settings that question the realities of learning space use and performance.

However, first we must frame the context for these emerging scholars' insights – the purpose of this chapter. Initially it questions some assumptions that have arguably limited the scope of past learning environment evaluations. It then argues that evaluation has a mandate to be a central focus in future learning environments research. Thirdly, it summarises a cross section of issues that are emerging through innovative post-graduate research on this topic in Australia and overseas. Finally, it introduces a sample of such research to be explored in the following chapters of this section: Mark Osborne, Lindy Osborne, David Clarke and Chris Bradbeer are leading learning environment practitioners whose expertise in design and education is now being energetically replicated into doctoral research. These authors probe the more complex edges of current research and identify a number of issues of importance that remain unexplored in learning environment evaluation. Their identification of such voids highlights the range of issues learning environments evaluation must encompass.

This first section of *Snapshots* lays the foundation for understanding the scope of what we need to investigate in order to determine if new generation learning environments are actually 'working'.

#### A HOUSE OF CARDS?

What then are the 'issues' to be addressed in learning environment evaluations? It is wise to first step away from the specifics, and consider how the broad discourse of learning environment research has evolved. Part of this broader perspective is coming to grips with the somewhat patchy evidence-base of evaluations to date.

It is no accident that the title to this introductory chapter contains two assumptions and one question. Inherent to any conversation about emerging issues in research is to first establish a firm foundation of understanding; what do we already know, what is plausible but not yet proved, and what is an issue of merit but presently still conjecture? The title encapsulates these three elements and does so at this early stage of the book so an epistemological stance can be declared.

Such a statement of intent is important. In the mid years of this century's second decade we have witnessed a frenzy of building education infrastructure, the like of which has not been seen since the post-war years. It has been understandable that researchers designers and educators, excited by such rapid development, have been quick to argue a commensurate paradigmatic change in teaching and learning. This discourse has at times surpassed its corroborating evidence. For example, research is often based on a claim that past education was factory-style didactic instruction, where as innovative learning environments now spawn collegial experiential learning. On occasion this creates an almost evangelical passion for 'new pedagogies', which are supposedly either created by or developed for such spaces. For the sake of effectively evaluating impact, these assumptions require repositioning in the light of reality; not because the phenomenon may be untrue, but because without factual evidence we may be constructing new hypotheses on



the back of exciting but unproven assumptions. In short, we may be building a house of cards. We need evidence to accurately articulate the current circumstances that underpin future research, because assumptions make flimsy foundations – once one is disproved, one card removed, all can come tumbling down. For this reason, *Evaluating Learning Environments* begins by stating its position on three critical areas pertinent to learning environments evaluation, and does so using the assumptions and question inherent in this chapter’s title.

### *Do Innovative Learning Environments Actually Exist?*

Firstly, the title boldly asserts ‘new generation learning environments’, assuming that these are a fact. On this we must say we are in agreement; new-age learning environments are a reality. In a physical sense they exist, and do so in growing numbers. Perusal of designs for the annual A4LE Awards (*Association for Learning Environments*) is one indicator. Completed designs submitted for judging are nearly always eye-catching, inspirational, imaginative and exciting. More importantly, they use the latest materials and surface treatments. Their furniture is bespoke or, if not, is well considered to suit a range of users and uses. The designs embed the most recent thinking in terms of sustainability and ICT integration. They exhibit superior building performance in terms of lighting acoustics and airflow. Their designs make effective use of building sites, the potential for community engagement, effective outdoor/indoor treatments, and formal and informal use of spaces. These most recent designs are innovative in that they own features that – in the main – have only recently been embraced by schools and school planners, save for a short period in the mid 1970s. They exhibit qualities that through a lack of imagination or technological development have been absent in most school and classroom designs of previous generations.

Another indicator of the innovative nature of these designs is their capacity to elicit unsolicited attention from an audience extending well beyond educators and designers, into the public domain. With conversations including bold statements such as ‘the classroom is dead’ (“All in together”, 2011) and claims that these designs signify a ‘groundswell movement’ that will ‘radically transform schools’ (Knock, 2011, August 2nd), innovative learning spaces are now the type of disruptive intervention that hallmarks significant change in established thinking in education. We applaud the vision of our current generation of school designers and accept that these are, very much, designs that speak to the future.

### *Do the Design Qualities of New Generation Learning Environments Address the Educational Needs of the Future?*

Secondly, in asking “How do we know if what works is working...?” the title assumes these designs are successful in that their plans provide what is needed for the teachers and learners of today and the future. On this assumption we are in

conditional agreement. These design qualities match the theoretical educational needs of what is now frequently termed the '21st century learner'. Characterised this way by the Melbourne Declaration (MYCEETA, 2008) and other influential publications (OECD, 2013), the argument is that today's students must train for a future society and workforce that will demand skills and expertise qualitatively different to that of any preceding generation. The mantra of the mid-2010s is specialist 'knowledge economy' skills that will enable established economies to maintain competitiveness in an emerging Asia-centric knowledge marketplace (Department of Industry, 2013). While a detailed explanation of the characteristics of the '21st century learner' is beyond the scope of this chapter, the implication for innovative learning spaces is that design must facilitate so-called 21st century learning styles. Comments such as those below are common when articulating these qualities:

Students are experiencing an explosion in information... Its better to teach them to access and process information, than to get them to commit a small percentage to memory...

Teachers must be freely accessible to all and not stay at the front of the room...

Students learn well, even better, from each other...

Spaces must allow students to use peers as fellow learners and teachers, and look to teachers as resources to help that learning...

Classrooms with flexible furniture and moveable walls are needed to allow freedom of movement, access to resources...

Students need individualised learning plans, individualised assessment strategies... spaces that provide the capacity to match a student's knowledge needs to a team of teachers, not just one...

Spaces must reflect that no two students are the same, learn the same.

On matching spaces to such perceived student needs, designers have been quite successful. There is little doubt that new generation learning environments should accommodate multi-modal learning and teaching styles, from the didactic to the highly individualised. They are ICT infused, with multiple ways for teachers and students to use new-age technologies in their teaching and learning. They are flexible in their floor plans, often allowing uninterrupted flow between spaces and free access to key learning areas. They are designed so students and teachers can collaboratively construct learning hubs, specialist groupings, and sites for learning that suit a particular task at a particular time. In short, these spaces have, on paper, removed the teacher from the front of the classroom, the student from the restrictions of classroom learning 'cells', and learning from predominately direct instruction to largely exploratory investigation of concepts. New generation learning environments have turned the focus onto each student's individual need. They are,

as close as a design can achieve, places and spaces that are student focused and facilitate multi-modal, ICT infused, student-directed learning.

However, we must remain mindful that a learning environment is an amalgamation of its physical design and the practices that happen within. They cannot be separated and in this context must be considered an analogous whole, and summarised in the simple formula of design + practice. Profound complexities exist concerning this phenomenon of inhabitation, explored by Bachelard (1994), Foucault (1984) and others, efficiently summarised by the observation the space we occupy has an irrefutable impact on us; "...we make it, it makes us" (Moore, 2012, p. 70). How it is actually occupied is an intractable part of the equation of 'what works', and we cannot assume that a learning environment is 'working' based on its design and the practices it *theoretically* elicits. Likewise, we *can* determine 'what works' if we have a realistic appraisal of what is occurring in its spaces. In other words, a learning environment's practice must be tangible, not aspirational, before any quality evaluation can be planned and implemented.

It is here we strike some difficulty. Arguably, there is little that is historically new occurring in new generation learning environments. The types of practices noted in the dot points above are not new concepts in teaching and learning; they are actually part of a long evolution in educational development. The quotes were retrieved from an archive of 'open classroom' material from the 1970s ("Why we think 1970s Open Education failed", 2014), forty years old but relevant still. Their age starkly demonstrates that in the mid 2010s we are not witnessing any huge change in student needs.

In fact, many of the core needs claimed to be 'unique' to the 21st century were clearly articulated in the Plowden Report exactly fifty years ago (Plowden, 1967). This report built the UK's open plan classroom and teaching strategies on constructivist theories of learning presented by Vygotsky in the 1930s. Dewey's well understood beliefs from the early 1900s about linking education and experience were widely accepted. Dewey's theories spring-boarded off Pestalozzi's 1820s call for a move away from 'formality of instruction through lessons recited in unison, answers to questions based on memorised replies', to a model of schooling that 'stresses the value of activity' and 'education as growth rather than the acquisition of knowledge' (Hilgard, 1996/2004, p. 990). Pestalozzi's theories were, in turn, a development from Rousseau's concept of how education must develop 'active and thinking beings', which were articulated through *Emile* – published in 1762 (Rousseau, 1762/1979).

Thus, the element of doubt we expressed regarding the second assumption in the title does not stem from what it says about today's classroom designs, but from its implied belief that to be successful the practices within these spaces must be as uniquely different as their designs. This runs counter to the reality of how education evolves. The assumption that learners of today have unique and unprecedented needs is only partly sustainable – some ICT practices are one exception. The full gamut of issues that need to be addressed in any evaluation must also embrace theories

and curriculum and pedagogy developments that span more than 250 years. Criteria used to judge these spaces are considerably more complex than simply assessing if the spaces are making students digitally ready for society's next development.

There is scant evidence that in relative terms today's learners' needs are significantly different to previous generations, and there is ample evidence that innovative teaching has always existed (Godhino & Imms, 2011). Thus, our conditional acceptance of this, the second assumption in the title, recognises that new generation learning environments are indeed innovative, the practices within are less obviously so, and this reflects the reality of a slowly evolving educational phenomenon. Thus, if the unit of measurement is the new generation learning environment, the unit of analysis is more complex; this is the sum of the design and *actual* practices within, divided by (or examined within the context of) the potential measurable learning that good teaching can facilitate. The equation should read:

$$\text{NGLE effectiveness} = \frac{\text{Design + practices}}{\text{Aspirations of 21st Century learning/teaching}}$$

Current designs may well be a significant leap from what has come before, but the teaching and learning that occurs within is part of a slowly evolving phenomenon, it is iterative in nature and must be evaluated as such. It would be problematic to link evaluation of new generation learning environment designs to a unique learner concept that is futuristic, undefined, and in many respects blind to historical precedent.

#### EVALUATION, THE PANACEA FOR WHAT AILS

##### *Can We Actually Evaluate the Impact of Learning Environments?*

Having situated *Snapshots* in terms of the two assumptions embedded in this chapter's title, we now turn to its primary question – how do we determine if 'what works' is actually working? Can space be evaluated in terms of its impact on teaching and learning? If history can provide a measured interpretation of what actually constitutes '21st century learning', it also provides sound lessons for the evaluation of learning environments. The following section will determine how far past learning environment evaluation practices can inform those required to assess the impact of the 'new generation' variety.

History teaches us that practices associated with open learning environments have, for decades, constituted one part of a progressive reform agenda in education. For example, Dewey's 1890s laboratory school at the University of Chicago, Neill's social-democratic 1960s Summerhill School in the UK, and Italy's Reggio Emilio early-childhood environmental educational philosophy all utilised spatial manipulation in pursuit of differentiated learning – their versions of what we now summarise as '21st century learning characteristics'. The huge open plan movement

in the UK, USA, Australia and many other countries in the 1970s pursued a similar goal. Each flourished, each faded, and each revisits our consciousness on occasions in the form of a new initiative. Sherman (1990) laments this cyclical nature of education as being a distraction to the point of an illness. Her regret is not so much education's slowness of change, but its seeming incapacity to *sustain* change. That incapacity, she argues, stems from "...pitfalls of bandwagon movements that are born from serious reform efforts but falter with shifts in the political and social climate" (p. 44). Good evaluation, *Evaluating Learning Environments* will argue, is the antidote to the sickness of 'bandwagon' cyclical developments in education. We make the point that sustainability comes from good evaluation practices; if we know 'what works' we can build on past successes rather than be condemned to repeat past failures (Santayana, 1998).

It is sobering to review evidence concerning the 'failure' of the open plan movement. Political factors weighed heavily, predominately centred on 'back to the basic' rhetoric. Figures such as Rickover (1963) argued the USA was falling behind the Soviets in technological development, 'soft' schools were at fault and, as he later famously argued to one hearing, education was too important to be left in the hands of educators (it should be noted that this was on the back of Russia successfully launching a human inhabited satellite before the USA). Similarly in Australia and the UK, a reported fall in literacy and numeracy standards coincided with fear of technologically superior regional neighbours to drive a direct-instruction agenda. Social factors also influenced the demise of open plan classrooms. The western 'cultural revolution' brought about by reaction to the Vietnam War, racial and class activism and civil rights issues, which in part created the environment for open plan schooling, experienced a conservative backlash in the 1980s as economies faltered. This coincided with some negative public opinion about open plan classrooms; children being lost in classroom confusion, directionless in their learning, and teachers incapable of educating collaboratively or monitoring individual progress efficiently (Hunt & Yarusso, 1978).

Perhaps the most sobering lesson from open classrooms' demise was the lack of evidence-based arguments for their closure. Research specific to the impact of learning environments, in particular their effect on student learning outcomes, was rarely cited. While evaluations were available, the quality was poor and, not surprisingly, they were infrequently cited during policy decision-making processes. Without convincing evidence, negative attitudes ruled the day.

In 2009 Hattie published a synthesis of over 800 meta-analyses of educational research relating to achievement. It evaluated findings from hundreds of thousands of educational studies to create a hierarchy of factors with demonstrable effect on student learning. Of the 138 categories he identified, 'open versus traditional' classroom practices was ranked a lowly 133rd with no discernable contribution to improving student achievement. He concluded the practices of multi-age grouping, the use of open classrooms, and team teaching had no significant effect on student

learning outcomes. However, far from putting a final nail the coffin of the importance of spatial design of schools, Hattie's synthesis can be used to identify the principles for their effective evaluation in the 2010s.

Hattie's (2009) synthesis utilised four meta-analyses that addressed the measurement of learning outcomes in 'open versus traditional' scenarios, involving 315 studies with 333 findings. Each meta-analysis 'mined' published studies for claims of effect, and categorised these effects into weighted averages. The synthesis, a meta-analysis of meta-analyses, was inconclusive to the extent no positive effect was found against a benchmark of  $d = 0.4$ . Hattie's conclusion that "open classrooms make little difference to student learning" (p. 88) reads as a confirmation that the late 1980s return to traditional classroom design and more formal teaching practices, was justified. They had, at best, the same impact on student development as their alternative. Based on the data at his disposal Hattie's finding was quite accurate. However, systemic flaws inherent to the contributing meta-synthesis suggest the issue of evaluating learning environments' impact on student learning is not the done and dusted deal Hattie's edit might suggest. They highlight four qualities that must be better managed in contemporary evaluations.

The first is that Hattie could not control the quality of the data contained in the 315 studies. These were often questionable; Gray (1978) argued research on this topic was so poorly conceptualised and designed that no useable guidelines for assessing or developing open classroom strategies were possible. He claimed the majority of studies conducted in the 1970s failed to define key concepts, avoided the longitudinal designs required to assess impact beyond an 'initial setting in' time, and regularly used unsatisfactorily small sample sizes (p. 51). Instruments for measuring achievement biased traditional classrooms (Doob, 1974). The meta-analysis methods consistently ignored aspects of the participating studies that should have impacted the final conclusions (Mansfield & Busse, 1977). Differences in definitions, sample sizes, design and analysis resulted in the warning that "...not all studies could be considered as equal" (Marshall, 1981, p. 82), but never the less were used in meta-analyses (Horwitz, 1979). Irregularities in findings of studies indicated poor consistency between measures of 'openness' and outcome variables (Jackson, 1980). While no area of research can boast consistent research quality, 'open program' research from the 1960s and 70s appeared unusually prone to concerns regarding research design. When evaluating learning environments we must maintain consistent high-quality design across learning spaces evaluation, and core to this is ensuring the provenance of assumptions core to any evaluation.

The second issue concerns the age of the data. The four meta-analyses were conducted between 1980 and 1982. Hattie's edict that open classrooms had no effect must be considered in light of concerns about the quality of research at that time, and the fact that this conclusion was based on data over 35 years old. Even assuming the 333 studies were scholarly, a finding of 'no effect' in the 1970s cannot be used to plausibly claim a similar trend exists in the 2010s. This is particularly problematic when one considers the types of practices characteristic of 'open

programs' such as team learning, activity-based, self-directed learning, are all well embedded in primary or elementary classrooms of the 2010s. Clearly, these were practices that did 'have an effect'. The second issue, then, is that evaluation data must be relevant to contemporary situations.

The third issue is that clear definitions of key concepts are mandatory. What is being measured in these 333 studies is the third issue. Hattie's defining category is 'open versus traditional'; it goes no further, but suggests in-text that this refers to 'programs' (p. 88). Defining an 'open program' proved problematic in the 1970s with studies "...not all hav[ing] used the same measure of openness..." (McPartland & Epstein, 1978, p. 133). A criticism made of key meta analyses at the time (for example Glass, 1976; Peterson, 1980), this point is made consistently by Horwitz (1979), Jackson (1980), and Marshall (1981) who each tempered their findings with cautions about assuming the term was used consistently across all, or even some, studies. Ironically even McPartland and Epstein's study that explicitly intended to address this anomaly by testing for differences between 'open' and didactic instruction using a large sample (N = 6,225) fell victim to poor stipulative definitions. Only one of their seven items used to identify the program type was unambiguously characteristic ("In class the teacher stands at the front and addresses the class as a whole") (p. 143). The remaining six could equally have applied to didactic or open learning/teaching styles. To further confuse this research, 'Open programs', however, were often taught in both traditional and open-plan classrooms (Gray, 1978).

The fourth issue concerns how 'effect' is determined, or in other words, what counts and what does not count? Hattie bases his edict on studies that produce a measurable effect. While understandable, this produces a finding based on limited data, what McPartland and Epstein (1977) refer to as a "batting average of successes and failures" (p. 133). An example of how this proves problematic is contained in a USA summary of over 30 'open program' evaluation studies (Educational Research Service, 1974) that included the variables and findings briefly summarised in [Table 1](#).

The variables being addressed are insightful and informative. It is not a meta-analysis in the true sense as effects were not categorised and calculated to achieve weighted averages. It is possible that some may be represented amongst the 333 in the four meta-analyses used by Hattie but there is no method to verify this. What is problematic is that findings were used despite researchers (Gray, 1978) and even the authors of the actual meta-analyses used by Hattie cautioning the reader of the veracity of their data (Marshall, 1980; Horwitz, 1979). In the process informative findings were excluded because they did not report an empirical effect. A message from this, is that even the most methodologically rigorous approaches have drawbacks that impact on the legitimacy of findings. The fourth issue then, is that there is no such thing as purity of data. Good learning environment evaluations can and should be based on rigorous and quality benchmarking, but should also be considered legitimate if otherwise non-compliant data passes a 'reasonable assumption' judgement.



*Table 1. Summary of studies, Research on open education  
(Educational Research Service, 1974)*

<i>Variables</i>	<i>#</i>	<i>Findings</i>
Student achievement	7	Two significant findings favourable of open programs in primary schools, one statistically insignificant finding. High school studies found one favourable of open programs, two statistically insignificant. Researchers cautioned that the measurement tools favoured students in 'traditional' settings.
Student self-concept	3	One study found students in open programs had higher measures of self-esteem. Two studies produced statistically insignificant findings. Boys' self-esteem was significantly higher in open programs.
Student behaviour	3	Open programs produced higher levels of student academic confidence, greater intellectual independence, better use of time, fewer incidents of disruptive behaviour.
Student attitude	5	Four studies found statistically significant findings on student attitude favourable to open programs, one study the reverse. Boys' attitudes to learning were improved in open programs.
Transition (OP to trad)	1	Students from a primary school open program found transition to high school easier than traditional program peers.
Teacher opinion and morale	6	Of two high school studies of teacher opinion and morale, one was in favour of open programs, one the opposite. Of primary teachers, one found morale lower in open programs. A study of inexperienced teachers was favourable to open programs. Teachers in small, informal open program 'teaching teams' were more satisfied than colleagues in large teams. No one personality 'type' suited open program teaching.
Parent and community reaction	4	Three studies were favourable to open programs, one showed no significant result. A 'community and police opinion' study was in favour of open programs.
Administration roles	2	One study found a need to free Principals from administration in order to focus on in-service training and leadership.
School costs	1	Open program schools allowed for increased enrolment capacity, a more diversified program, and increased floor space for instructional use.

This section has briefly explored past research to determine what lessons history teaches us about good learning environments evaluation. It makes the point that much that has been done in the past has been of dubious quality, and has led to sometimes erroneous conclusions, highlighted in particular by Hattie's definitive statement about provable impact of classroom design. The core message is that if education is indeed doomed to cyclical bandwagons, *quality* evaluation is the



panacea that will ensure learning environment designs are not just another fad. But this must be based on sound evidence. Upcoming learning environments evaluations must maintain a high standard of research, must ensure data is relevant to current developments, must maintain consistent definitions of key concepts across all evaluations, and must ensure a balanced choice of what data is deemed ‘of use’.

#### FRAMING THE ‘ISSUES’ RELEVANT TO LEARNING ENVIRONMENT EVALUATIONS

There exists a suite of issues surrounding the concept of *change*. Learning environment evaluations need to address issues of behavioural change, in particular the ways we can measure teacher use of NGLS with the aim of improving uptake of the affordances of these spaces. Of a similar ilk, evaluations need to address issues of change management, in particular identifying the qualities of school leadership that generate sustainable effective practices in NGLS. Is it possible to develop an evidence base that helps to predict the most effective strategies for school principals and management teams to effect sustainable improvement in the use of these spaces?

There exists a suite of issues surrounding the concept of *design*. How do we utilise evaluation to ensure the design of NGLS will meet the learning needs of so-called ‘21st century learners’? How do we evaluate building performance, in particular, acoustical qualities, air quality, lighting quality, pedestrian ‘flow’, and how these effect learning and teacher/student ‘inhabitation’ of NGLS? What is the affect and effect of furniture and other ‘situated’ artefacts within a learning environment? What role can school design/implementation professionals play in assisting the effective ‘inhabitation’ of ILEs, beyond post-occupancy?

Many issues also surround the concept of *pedagogy and curriculum*. What constitutes ‘innovative’ in terms of spaces and pedagogy? Without guiding principles, evaluations run the risk of comparing apples with oranges. Evaluation must provide us with robust frameworks for structuring any analysis of the educational impact of space. What do NGLS enable in terms of ubiquitous ICT usage, and what is the impact of such approaches? What are the best approaches to collaborative teaching in ILEs? How can teachers manipulate or ‘curate’ learning spaces for desired learning outcomes? How do teachers respond to formalised and informal curriculum in NGLS configurations, and in particular what spatial qualities might motivate, hinder, or facilitate teachers’ attempts to achieve deep learning outcomes with their students? How can NGLS make curriculum, or even teachers’ pedagogies inclusive for those with learning and physical disadvantages?

There exists a suite of issues surrounding the concept of *measurement*. How do we isolate the variables identified in the previous paragraphs within a schooling situation that has steadfastly resisted empirical evidence? It is generally accepted that the mass of confounding variables existent in the complex world of a schooling environment makes even quasi-experimental approaches to evaluation problematic.

It is just these types of data that are required however, if we are to make a balanced judgement about ‘what works’. Measurement may be the most critical issue facing learning environments research. As the earlier conversation concerning Hattie’s (2009) synthesis of meta-analyses pondered, the quality and range of learning environment evaluations is constricted by what counts for valid data and how these are used.

The above is not an exhaustive list. It highlights how complex the phenomenon of learning environments has become in recent years. Attempting to make sense of one aspect of this growing field – evaluation – is the purpose of *Evaluating Learning Environments*. This chapter began by unpacking some assumptions rife in learning environment development, with the purpose of situating *Evaluating Learning Environments* epistemologically in what has come before. It argued that we are destined to revisit past successes and failures unless we learn from history and build on evidence of good practice. Where this quality evidence does not exist we must develop robust bodies of knowledge to ensure any future outcomes are judged on fact, as opposed to conjecture and popular sentiment. It made the case that sound evaluation was the key to sustainable learning environment development, and that the issues that constitute what is required are wide ranging and complex.

The following four chapters are snapshots of what is required in the coming years, examples of the ‘emerging issues’ in learning environment evaluation. David Clarke explores the exciting phenomenon of the architect as an active agent in the inhabitation of NGLS. By inhabitation I refer to the extension of ‘occupation’; what happens over time, as compared to simply moving in. Habitueés actively and consciously manipulate their environment to pursue a set of scholastic and personal needs that often have little to do with what was planned (Imms, 2015). The architect, argues Clarke, with her/his knowledge of the design process and the nuances of living within a space, has a great deal to offer learning environment evaluation of how people live within the spaces they designed. Chris Bradbeer explores the issue of teacher collaboration, not as a product of a particular NGLS design but as a precursor and driver of that design. His example is the antithesis of what occurred in the 1970s where teachers were ‘parachuted’ into innovative learning spaces with little consideration given to what they might actually do, and what support they required. Mark Osborne writes of his emerging research into change management, of the structures and process that can be borrowed from other disciplines to assist leaders as they move often large school populations into new and challenging learning environments. Lindy Osborne explores change from the perspective of the training institution. How should a large and well established body of practice like a university modify and re-invent itself based on evidence of effective practices elsewhere? Embedded in this evaluative approach are, we suspect, answers to questions currently being raised by school departments and ministries of education: what is required to change the mindsets of educators to make the most of the affordances offered by NGLS?

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### 3. WHAT WORKS

#### *Changing Practice When Spaces Change*

##### CONTEXT

In 2010 and 2011 Christchurch, New Zealand suffered a series of catastrophic earthquakes that left tens of thousands of city, buildings damaged and hundreds of people dead. Many public buildings across the city, including schools, were damaged beyond repair and the programme to rebuild them has resulted in one of the largest school network renewal projects the world has ever seen. The New Zealand government has invested more than NZ\$1.1 billion to rebuild and renew 115 schools (New Zealand Ministry of Education, 2014a, p. 1). An explicit goal of the New Zealand Ministry of Education through this process was to make what they call “modern learning environments ... common throughout greater Christchurch” (2014a, p. 2).

The New Zealand Ministry of Education (2012) also set out a number of other objectives for the programme, namely, to “improve the delivery of education, extend the options available for learners, and lift student achievement”, “support the establishment of modern learning environments designed to meet the needs of the whole community”, build “fewer schools offering a wider range of educational options and specialised training that give greater Christchurch a distinctive advantage”, offer “single site provision of early childhood education (ECE) through to tertiary education, alongside a range of other services”, and share facilities “to extend the learning opportunities available to a wider group of learners” (p. 2).

The New Zealand Ministry of Education made it clear that the rebuild was an opportunity to rejuvenate buildings and pedagogy to better serve student learning:

The majority of school buildings were built between 1950 and the 70s. Since then, teaching practice and student learning needs have changed significantly. New technologies and building materials allow for new, vibrant and well-connected learning spaces. All students deserve to be taught in these new modern learning environments, and benefit from new teaching methods. (2014b, p. 1)

The programme for the rebuild is set to progress until 2023, and includes three distinct categories of build that reflect the scale of the work being undertaken; (1) restore – repair of earthquake damage, remediation of weather-tightness and

building resilience issues; (2) consolidate – rationalisation, mergers, closures and co-location, and (3) rejuvenate – consideration of future educational provision for the most significantly affected schools, in terms of damage to facilities and sites, and movement of people (New Zealand Ministry of Education, 2012, pp. 8–9).

One can see from the scope and complexity of these priorities that the rebuild programme is ambitious and multi-faceted. Achieving goals such as the improvement of student achievement, raising community participation in education, co-locating and vertically aligning education providers, and making improvements to access and inclusion will present significant challenges.

As school leaders guide their staff, students and communities through this process, their abilities to lead change will be tested. They will need to draw from research into effective change leadership and apply what they learn to their own work, rebuilding not only the physical environment, but also cultural, emotional and social environments as part of the process of reimagining what school might be. Staff, students, parents and communities will be challenged by the process of moving from pedagogies and practices that have been shaped and guided by industrial-era classrooms to pedagogies and practices that can make the most of open, flexible, and collaborative teaching and learning spaces.

A number of people and organisations are working in Christchurch to support schools through the change. The writer's role as a consultant for a not-for-profit organisation was to do exactly this. The role entails helping schools develop and articulate a vision for learning, and to design and develop not only the buildings, but also the human capabilities, dispositions and support structures required to ensure this vision is achieved. This means drawing on experiences in a wide range of schools as they redevelop their built environments and their approaches to teaching and learning.

#### OBJECTIVE

While there is a body of change leadership literature that can help us to understand change and offer some general guidance on how to navigate it successfully, what is missing is specific advice on changes related to physical learning environments. The size of the financial investment in New Zealand and the opportunities to raise outcomes for learners means that it is particularly important to get this right, despite some researchers estimating that “only 30% of change programs are successful” (Aiken & Keller, 2009, p. 1).

With many of the 115 Canterbury schools facing significant change as their physical environments are remodelled and rebuilt, it is important to evaluate the change leadership strategies that are most effective when it comes to shifting teacher practice once physical spaces change. The essential question is: “What can leaders do to increase the likelihood that 19th century pedagogy is not imported into 21st century spaces?”

The challenges for those leading schools through this change are significant: i.e. setting out a compelling vision which can generate energy and act as a touchstone for new practices; building staff capacity in new approaches such as co-teaching, engaging with community to help them understand the changes taking place; and supporting staff as old strategies are replaced.

Schools may benefit from a deeper understanding of change leadership as it applies to Modern Learning Environments. (1) School leaders may find it easier to implement change, and the chances that their change will be successful will most likely increase; (2) teachers may find not only that their voices are listened to in the process, but that they are also given more ownership and control of the change process; and, (3) all parties may find that the change is more of a positive experience, less stressful and less emotionally taxing.

Current research suggests there are a number of things that school leaders can do in order to maximise the likelihood that change is positive and that it achieves the intended outcomes. Some are discussed below.

### *Understand the Nature of the Change*

For many teachers, students, parents and school leaders, the move to open, flexible, collaborative learning environments represents a significant departure from “business as usual”. Rather than being an incremental adjustment to schooling, this is a total transformation that challenges almost every aspect of the system, from identity and the roles that individuals play, through to the metrics used to measure success.

Many scholars including Heifetz and Laurie (1997) and Waters, Marzano, and McNulty (2003), refer to two different types of change as people commonly experience it. (1) *Technical* (or incremental) change refers to change that is an extension of the past, which sits within existing paradigms, is consistent with prevailing values and norms, and can be implemented with existing knowledge and skills. (2) *Adaptive* (or transformative) change represents a break from the past, sits outside existing paradigms, conflicts with prevailing values and norms, and requires new knowledge and skills to implement (Waters et al., 2003). For many teachers steeped in the “single cell” tradition, a move to modern learning environments represents adaptive change.

Given that different support structures are required depending on whether the change is technical or adaptive (Waters et al., 2003) and that the same change can be experienced by different people within an organisation as being both technical *and* adaptive, it is important to ask what kinds of support systems lead to the successful implementation of change? An added complication is that change often leads to people feeling personally threatened because the skills and strengths for which they have been valued and respected in the old order may not be as important or valued in the new order (Heifetz, Grashow, & Linsky, 2009). This acknowledgement is

crucial for leading change because people who are feeling threatened or unsafe are less likely to fully engage the rational, logical part of their brain. So while the change might sound perfectly reasonable, rational and common sense, this doesn't guarantee that people will fully engage with it if they are feeling personally threatened.

### *Build 'Change Readiness'*

Armenakis, Harris, and Mossholder (1993) suggest that resistance to change is most likely to be minimised when employees are 'ready' for the change. They describe two conditions required for this to occur. The first is the communication of a clear message of discrepancy between the status quo and the desired end change state, which can be labelled *cognitive dissonance* or what Kotter (1996) describes as the creation of "a sense of urgency" (p. 35). The second condition is the development among those engaged in the change of the understanding that they have the necessary knowledge, skills and abilities to cope with the change. In short, there should be an understanding of the need to change and a belief that those involved are collectively capable of undertaking this change (Armenakis et al., 1993).

Another contributing factor to a person's level of change readiness is the level of their commitment to the organisation. McKay, Kuntz, and Näswall (2013) have shown that individuals who are personally aligned with the values and goals of an organisation are more likely to commit to change that is intended to advance those values and achieve those goals.

### *Adopt a Leadership Style That Is Appropriate to the Context*

It seems that 'change readiness' and affective commitment to the organisation can lead to an increased likelihood that teacher behaviour will change, but there are other leadership practices that can contribute to the success or failure of a change initiative. Connor (as cited in Bowman, 2000) suggests that *continuous* and *integrated* leadership are the only styles that can cope with adaptive change, and that leaders often need to manoeuvre through a menu of change leadership styles to manage what he describes as 'torrential' change. *Integrated* leadership is described as "balance[ing] concern for both the human and technical aspects of change" while the goal of *continuous* leadership "is to generate a sustainable adaptation capacity to ensure that the change leadership initiative at hand does not consume all of the organization's assimilation resources" (Bowman, 2000, p. 447).

### *Engage in Participatory Planning and Problem-Solving*

Furthermore, research suggests not only that inclusive, participatory knowledge-creation is desirable, but that it should begin as early as possible in any adaptive change process. Miller and Monge (as cited in Holt, Armenakis, Field, & Harris, 2007) suggest "those who participate in planning and implementing change often



have the opportunity to influence the change [...and] tend to become affectively committed to the change effort and support the change overtly” (p. 245), and that establishing these participatory, generative, problem-solving processes early on will increase the likelihood that change will be successful.

### *Engage in Sense-Giving, and Promote Useful Sense-Making*

Research also suggests that crucial to the successful implementation of adaptive change is the timely and adequate provision of information regarding the change throughout the process. Levels of change-related anxiety tend to reduce when employees receive useful and timely information (Miller, Johnson, & Grau, 1994). Participants’ interpretation of this timely and adequate information is also an important factor, and when such information is received, employees tend to evaluate change more positively and exhibit greater willingness to cooperate (Wanberg & Banas, 2000).

### *Avoid Change That Is Perceived as Being of ‘Low Cultural Fit’*

Another factor that is positively correlated with successful change implementations is the level of *cultural fit*, or “the compatibility between a new practice and the existing organizational culture” (Canato, Ravasi, & Phillips, 2013, p. 1724). If introducing changes to practice such as moving teacher allocations from 1:25 to 3:75 or abandoning individual teacher planning in favour of team planning is incompatible with the prevailing norms and practices of an organisation, research suggests that the change is likely to be “fragile and subject to regression” (Kotter, 1996, p. 102).

What happens in cases when teachers, through the rebuild of their school, are forced to implement strategies and practices that are a low cultural fit with prevailing beliefs and values? If, for example, a school has a long tradition of autonomous teachers operating in their own “single cell” classrooms, making unilateral choices about the right learning activities for a given group of students, and that same school is rebuilt using open, collaborative, flexible learning environments, what happens? Are the new “low cultural fit” practices adopted or abandoned? Or are they adapted, as Canato et al. (2013) found was the case? Or can new practices be re-positioned by leaders so that the appearance of them being of *low cultural fit* is avoided?

### METHODOLOGICAL CONSIDERATIONS:

Any number of methodologies might prove helpful when exploring the area of change leadership and flexible learning spaces. They include: (a) semi-structured interviews and/or questionnaires with leaders and staff to try to determine which strategies best support people through adaptive change; (b) discourse analysis

from within schools undertaking adaptive change to look at processes such as sense-giving and sense-making, and/or (c) support offered to staff experiencing change. The use of case studies that compare the approaches of different schools to Kotter's (1996) change leadership framework and determine the degree to which fidelity to this model is an indicator of success could be employed.

However, one area in particular that might prove to be more useful for the writer than others given his role in the process of changing physical spaces is the field of auto-ethnography. Because the writer is supporting schools through the change process, objectivity will be difficult.

Auto-ethnography seeks to "describe and systematically analyze personal experience in order to understand cultural experience" (Ellis, Adams, & Bochner, 2011, p. 274). The complexity of the changes being undertaken by the schools in Christchurch, their unique, personal experiences of grief and trauma through the earthquakes and the recovery, and the subjectivity of the researcher working closely alongside schools and communities as they experience the changes taking place, all lend weight to consideration of auto-ethnography as a valid method for documenting and making sense of the process the schools go through.

Anderson (2006) called his particular approach to auto-ethnography "analytic auto-ethnography" (p. 373). Different from other approaches such as evocative auto-ethnography, which Anderson (2006) described as seeking to "take us to the depths of personal feeling, leading us to be emotionally moved and sympathetically understanding" (p. 385), analytic auto-ethnography is "committed to an analytic research agenda focused on improving theoretical understandings of broader social phenomena" (p. 375).

Anderson proposes five features of analytic auto-ethnography: complete member researcher (CMR) status, analytic reflexivity, narrative visibility of the researcher's self, dialogue with informants beyond the self, and commitment to theoretical analysis. This methodology acknowledges researcher subjectivity while still providing an opportunity to answer questions centred around how to create an environment that encourages a shift in teacher practice when the physical learning environments change.

#### IMPLICATIONS FOR TEACHERS, LEADERS AND DESIGNERS

To summarise, current research suggests that change is more likely to be successful when leaders understand the nature of change, build change readiness, adopt a leadership style appropriate to the context, engage in participatory planning and problem-solving, engage in sense-giving, and promote useful sense-making, and avoid change that is perceived to be of 'low cultural fit'.

What these success factors look like will vary from school to school, but an auto-ethnographical approach to analysing the approaches taken by different leaders as they guide their schools and communities through adaptive change should provide an improved theoretical understanding of what increases the likelihood

that adaptive change will be successful. The following scenarios model this approach in action.

## THEORY INTO PRACTICE

### *Scenario One*

As her school moves into the planning phase of their rebuild, the Principal of a 600 pupil urban, multi-cultural primary school (Principal A) facilitates a series of community and staff meetings whereby people are invited to discuss what the school and education in general mean to them, as well as their hopes and aspirations for their children. From this, the school's existing vision and mission statement are renewed and extended, providing school leadership with a clearer mandate with which to embark on changes such as a curriculum review and the development of an educational brief for the design team undertaking the rebuild. This process also serves to clarify for parents who are new to the area what the school is about and what its priorities are.

Simultaneously, the school leadership team develops a communication plan that aims to both inform and engage parents and community members. Using a range of communication channels including the school's Facebook page, public meetings, newsletters and emails home, open afternoons and student-led conferences, the school leadership team link to a series of videos, research papers, blog posts and articles that help to explain some of the recent trends in education. These include recent studies on the brain and how learning occurs, the impact of technology on education, and research into the growing importance of creativity and unstructured problem-solving.

Each week a different classroom is showcased on the school blog, with commentary that helps to demystify the teaching strategies being employed. Particular attention is paid to classroom layout and the use of furniture to help parents and community members to begin to 'read' the learning settings being employed.

As well as aiming to inform parents and community members, the school also identifies a series of decisions that require parent voice, and give some thought to the best way for parents to be involved in these decisions. Parent input is sought when deciding on landscape designs, the location of parking and drop-off areas, and the kind of playground equipment to be purchased. A series of digital and face-to-face methods are used to empower parents in this decision-making.

### *Scenario Two*

In preparation for the wide-scale adoption of new-generation learning environments, the Principal of a 250 pupil rural primary school (Principal B) approaches two experienced, confident and enthusiastic teachers and asks them to begin prototyping elements of the kind of collaborative practice that will be possible in

the new learning environments. A modest amount of funding is made available to place a stacking glass sliding door into a wall between two classrooms and to allow the teachers to purchase some new furniture. These two teachers begin exploring the opportunities presented by this new environment. They set one room up for more teacher-led learning, and the second room for more student-led learning, and build student understanding of when to move between the two. Part of this prototype is regular reporting back to the rest of the teaching staff through once a month voluntary breakfast meetings. During these meetings, the two staff members describe over coffee and pastries the practices they are trialling as part of their prototype. They invite their colleagues to critique, ask questions and offer improvement, building a sense of collective self-efficacy over the changes taking place.

In addition, a working group is established to review the school's achievement data. Their remit is to identify areas of underachievement across the school and to work with teachers to support them to inquire into the effectiveness of their own practice. Professional learning groups (PLGs) are established to provide support for individual teachers, and together they begin to examine less effective teaching practices and explore new 'high potential' strategies. This process develops readiness for change and builds practitioner self-confidence.

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## 4. WHAT WORKS? EMERGING ISSUES

### INTRODUCTION: EMERGING LEARNING ENVIRONMENTS FOR ARCHITECTURAL EDUCATION

Diversification and expansion of global higher education in the 21st century has resulted in learning environments in architectural education that can no longer be sustained by the Beaux-Arts Atelier model. Budgetary pressures, surging student numbers, extensions to traditional curricula, evolving competency standards and accreditation requirements, along with modified geographical and pedagogical boundaries, are pointing a spotlight on the need for a review of the design of learning environments in the higher education context. The Architects Accreditation Council of Australia (AACA) course accreditation requirements dictate a 1:17 minimum staff/student teaching ratio as well as some aspects of space provision. Unsustainable specifications are driving the need to review pedagogical practices.

The influx of new digital technologies and largely ubiquitous access to affordable Wi-Fi-enabled mobile devices has helped to democratise knowledge and is transforming when, where and how students learn. This is having an impact on the types of spaces required to support effective learning. The traditional lecture theatre, with the teacher as sole conveyor of knowledge, is graciously now becoming a memory of the past. More efficient design of space that responds to this digital (r)evolution, has the potential to contribute significantly to savings in provision and management of learning environments.

Although many studies globally, and particularly those in the United Kingdom, have examined learning environment design, few studies have focussed specifically on the design of studio learning environments or the design of these environments for architectural education. While facing comparable changes and pressures, architecture continues to be taught in similar environments using similar pedagogical approaches to those first developed when it moved from an apprenticeship model to national higher education systems in the early nineteenth century at the École des Beaux Arts (Kostof, 1977). This chapter contextualises previous research in this area and provides additional insight into the emerging issues in the design of learning environments for architectural education in Australia. Using a grounded theory and thematic analysis mixed methodology, data obtained over a three-year period were interpreted to understand the significant relationships between spatial, technological

and pedagogical contexts and the impact that these have on teaching architecture students and preparing them for professional practice.

While definitions vary, in this chapter, 'learning environments' refers to the spatial, technological, social and pedagogical contexts within which learning occurs and which have an impact on student engagement, achievement and attitude. The description includes physical learning environments, blended and virtual environments, spaces and places, and on-campus and off-campus formal and informal environments.

#### LITERATURE REVIEW: THE FUTURE OF ARCHITECTURAL DESIGN STUDIO TEACHING AND LEARNING IN A NEW DIGITAL WORLD

##### *The Spatial Context of Learning Architecture in Australia*

One of the most significant assets of a university is physical space. In Australia the capital and operating expenditure represents about 20% of the average higher education institution's operating costs. Coupled with increasing competition for students and government funding, the provision of suitable space is becoming a high priority for universities (TEFMA, 2009). In his literature review on the learning spaces for the 21st century, Temple notes with disappointment that conventional texts on teaching and learning in higher education "do not mention the nature of learning spaces, even in passing" (2007, p. 10).

The whole landscape of spatial design and use is currently undergoing significant change. Harrison and Hutton describe it as "the hybridising of space, the dispersing of work, the annexing of non-traditional spaces or the freedoms and constrictions that come with new technology and the blending and layering of virtual and physical work arenas" (2013, pp. viii/1). The design of learning environments provides a great opportunity to lead the way into these new hybrid territories. Lifelong learning takes place in a multiplicity of spatial environments, both formal and informal, and is accessed through physical, virtual and hybrid communities. This rapidly evolving landscape includes purpose-built educational institutions as well as incidental spaces like galleries, conference centres, or the headquarters of professional bodies (Harrison & Hutton, 2013).

Reviews across the UK have revealed inefficient utilisation of higher education teaching spaces during core learning hours (Neary, Harrison, Crelin, Parekh, Saunders, Duggan, et al., 2010). The Australian Tertiary Education Facilities Management Association (TEFMA) reports that in order to achieve efficient space management and plan for future requirements, we need to better understand the current standards and benchmarks and utilise planning models to measure how well space is being used (2009). TEFMA's space planning guidelines have been specifically developed for this purpose. They provide useful space planning tools

which help to ensure effective, efficient and economical use of space that responds to the space requirements of institutions.

The TEFMA standards recommend that an appropriate targeted utilisation for architectural design studios in Australia is 56%. The targeted room frequency and occupancy are at 75% each, based on a typical overall week of 67.5 hours [8.00am–9.30pm, 5 days/week] (TEFMA, 2009). It is interesting to note TEFMA's recommended design standards for allocation of usable floor area (UFA) per student learning in an architectural design studio context. While it is 2.8m<sup>2</sup> for 1st year students, it drops down to only 2.2m<sup>2</sup> for more senior students (TEFMA, 2009). TEFMA also provides recommendations for the amount of dedicated faculty/department/discipline space typically required for different users. This is separately recorded from the central pool of timetabled spaces. At the department level, spaces vary significantly. For example, only 1m<sup>2</sup> UFA/effective full-time student load (EFTSL) is recommended for accounting, business management and economics students (who typically spend most of their time learning in generic spaces), while space provision for dental studies and veterinary science students (who are typically learning in specialist 'wet laboratory' type spaces), ranges from 16–18m<sup>2</sup> UFA/EFTSL. By comparison, the recommended UFA/EFTSL for architecture students is 8m<sup>2</sup> (TEFMA, 2009), which is an increase on the 2002 reported data of 6m<sup>2</sup>.

Dedicated faculty/department/discipline recommendations average at 46.8% of total campus space provision, with 5.2m<sup>2</sup> UFA/EFTSL, campus-wide. This is significant compared to centrally timetabled teaching spaces (lecture theatres, seminar and tutorial rooms), which only average at 9.4% of total campus space provision, with 0.93m<sup>2</sup> UFA/EFTSL, campus-wide. Interestingly, library space is comparable at 8.5% of total campus space provision, with 0.91m<sup>2</sup> UFA/EFTSL, campus-wide, and commercial space is not far behind at 4.81% of total campus space provision, with 0.51m<sup>2</sup> UFA/EFTSL (TEFMA, 2009). With the combined spatial provision of centrally timetabled teaching spaces, library spaces and commercial spaces averaging less than half of the spatial provision of dedicated faculty/department/discipline spaces, the importance of the provision of dedicated and specialist spaces is clearly evident. This is interesting to note in the context of current learning environment research which tends to focus on better understanding generic, rather than specialist learning environments.

TEFMA reports that a new concept emerging from recent university master planning in Australia is a move towards smaller cafés and outdoor eating areas: "These areas also provide for informal meeting space and the introduction of wireless technology also enhances the use of these spaces for both staff and students" (TEFMA, 2009, p. 14). They recommend that external cafeteria eating spaces that double as informal learning environments can be setup at 2–3m<sup>2</sup> UFA/EFTSL. It is interesting to note that this is much the same as their recommended standards for students learning in an architectural design studio context.



*The Social Context of Learning*

Jamieson argues that university campuses have been shaped historically by traditional pedagogical approaches and the classrooms required to support these. He defines informal learning as:

course-related activity undertaken individually and collaboratively on campus that occurs outside the classroom and does not directly involve the classroom teacher. Informal learning is generally viewed as those ‘other’ activities students do to learn between formal classes, including course reading, class preparation, and assignments and project activity. (Jamieson 2009, p. 19)

As informal learning has not been considered a serious matter in the past, universities have not committed significant resources to understanding and developing this pedagogical concept. However, attitudes and the balance of formal and informal settings are now changing as students are required to learn in a more self-directed manner. Jamieson believes that “the future campus will be determined by the university’s response to informal learning” (2009, p. 19).

William Mitchell, a professor of architecture and media arts and science, led the Smart Cities research group at the M.I.T. Media Lab. At a presentation at the M.I.T in 2004, he argued that the forms and functions of future learning environments would change rapidly to accommodate computer and communication technologies as architects discovered new ways to take advantage of them. He speculated that if new types of learning environments incorporated new technologies, they might also create new patterns of social and intellectual interaction. This would have an impact on the demand for physical space on campuses and suggest new approaches to overall campus design strategies, enabling the whole campus precinct to become an interactive learning device. He believed that all campus space (both formal and informal) with Wi-Fi accessibility should be considered as a potential ad-hoc classroom environment (Harrison & Hutton, 2013).

Oblinger (2005) asserted that a key learner-centered principle is that learning is social. Social learning requires student interaction, and therefore learning spaces should enable students to establish mutual relationships, engage in rigorous discussions, work collaboratively on group assignments and present or teach their learning outcomes in a public context. Mobile devices with Wi-Fi capability have now completely transformed the educational world. Students have turned nomadic (Alexander, 2004), accessing information and collaborating with each other outside traditional campus spaces and places. The impact that these new digital technologies have on learning spaces is summarised by Oblinger (2005), who argues that the definition of a classroom has transformed from one that was once defined by the class to one that is defined by learning:

The Internet has changed notions of place, time, and space. Space is no longer just physical, it incorporates the virtual. New methods of teaching and

learning, based on an improved understanding of cognition, have emerged, as well. (2005, p. 14)

In their University of Buffalo master planning case study, Dugdale, Torino, & Felix (2007) argued for the incorporation of ‘Hub Concepts’ to respond to user needs and aspirations about future pedagogy and concepts for exemplary social learning spaces. The concepts addressed the needs of three sets of constituents: the ‘Teaching Hub’ that contained clusters of experimental classrooms with academic technology support; ‘Learning Corridors’ that enriched the student realm by enhancing paths and circulation spaces near classroom activity; and the ‘Faculty Hub’ – a shared destination for interdisciplinary groups to meet and collaborate (2007). Jamieson (2009) also asserted that social hubs and internal student ‘streets’ within buildings that featured a mix of functions were the key features of campus life and supportively promoted both social and learning-related activities.

### *The Design of Studio Environments*

The design studio has been considered the primary context for design learning since it originated from the École des Beaux Arts in the early nineteenth century. Schön (1983) proclaimed that the main purpose of the design studio was to ‘coach artistry’ by operating as an environment where students are inducted into the ‘master mysteries’ through collaborative dialogue with their studio teacher who assists in shifting them into ‘disciplinary norms’. What is it about the design studio environment that has made it so special for the past 200 years and how does it need to adapt in order to keep pace with new pedagogical theories and approaches?

There is growing evidence that today’s architecture students no longer do significant work in their institution-provided design studio spaces. This is having an impact on the positive tradition of students working together in a collective environment and learning from each other and teaching staff as the need arises. These spaces are often insufficient in quantity and deficit in quality. Student complaints include “poor storage facilities for both work and personal belongings, inadequate (or non-existent) technology provision, insufficient pin-up space, poor atmosphere and lack of companionship” (Duggan, 2004, p. 72).

Furniture is often poorly maintained and inappropriate in supporting changing learning needs that include group and individual work, group crits and social learning opportunities. Similarly, inappropriate, or a lack of, technology is providing some barriers to students regularly using their studios spaces. As personal technology is becoming more accessible, affordable and mobile for students, their needs are changing. They no longer need the basic provision of desktop computers, rather, they need access to specialist equipment and software, printing services [both 2D and 3D] and appropriate technical support. These resources are not typically located within design studio environments, most of which are described

as technologically deprived. Duggan (2004) argues that, “greater student mobility accompanied by more complex juggling of both student and institutional priorities, more concentrated teaching days, poor quality studio provision and greater student reliance on technology, has resulted in the pattern of studio use shifting from live-in to drop-in, and the nature of studio identity being increasingly forged by events rather than space” (p. 73).

However, even if spaces were re-appropriated to encourage better student attendance, the current design studio educational model is still problematic. While students may appear to be working adjacent to each other, they are still typically working in isolation, often hiding their key ideas from each other and competing for the attention of the teaching staff. This is at odds with how they will be expected to work once they are in practice. Architects, even if working as sole practitioners on very small projects, never work completely independently. The act of designing and constructing a building is dependent on multiple people with different areas of expertise collaboratively contributing to its creation, and the architect is typically the party responsible for coordinating all of the works. However, current accreditation and institutional requirements uphold the “primacy of the autonomous designer by focusing all its attention on the student’s experience as an individual” (Cuff, 1991, p. 81).

In a design studio educational context, group work tends to be focussed around the beginning stages of design (for example precedent research and site analysis), while the design and documentations stages tend to be limited to individual contributions. This is because individual learning is a crucial requirement for current design studio education models. However, in professional practice, the contributions of other team members including other architects, consultants, and of course clients and end-users are of critical value throughout the design process (Koch, Schwennsen, Dutton, & Smith, 2002). Simultaneously teaching both individual and collaborative work skills is an unsolved challenge in the design studio context, and more experimental research must be done in this area.

### *Signature Pedagogies and Learning to Become Architects*

Today’s learners cannot be classified as a ‘typical group’ of high school leavers with generic learning styles and needs. They are juggling a multiplicity of different commitments, and their learning needs are rapidly changing. Mature aged students with competing time priorities cannot be defined simplistically and they are becoming increasingly common in the Australian higher education sector. In order to remain competitive, Australian universities need to address global issues and ensure that they are offering courses that are relevant and accessible to a variety of diverse learners.

Shulman’s theory of ‘signature pedagogies’ (2005) offers a helpful way of describing the social nature of design learning and how design studio practices may

come into conflict with pedagogical practices imported from different disciplines. Signature pedagogies are ways of teaching and learning situated in the professions (such as law, medicine and architecture) and which specifically focus on teaching students how to become practicing members of the profession. There is a direct connection between professional practice and the activities undertaken in the learning environment (Shreeve, 2012).

Significant past research has systematically pointed to the success of, and student's preference to, engage in an active learning strategy (Barr & Tagg, 1995; Bonwell & Eison, 1991; Jamieson, Fisher, Gilding, Taylor, & Trevitt, 2000). Active learning is a straightforward learner-centred principle. Typically, real-world problems are proposed and through these, learners practice their responses in a safe environment while receiving feedback from their peers and teachers. Students are required to be actively involved in their learning while engaging in higher-order thinking tasks such as analysis, synthesis, and evaluation. In order for students to successfully engage in active learning, instructional activities need to be aligned to support students to learn through doing (or observing), followed by thinking about what they are doing (or observing) through dialogue with themselves or others (Bonwell & Eison, 1991). The physical environment plays an important role in enabling learners to participate in the active learning activities (Osborne et al., 2012) which may include items such as interacting with people and information from outside the classroom, or engaging in simulation, virtual field trips, role playing, etcetera (Oblinger, 2005).

Transforming and extending the notion of active learning, more recent literature is now exploring the theories of connected learning (Nussbaum-Beach & Hall, 2012). Connected learning promotes learning that is humanitarian or socially focussed and driven by learner's interests or passions. These are then linked to academic achievement, career success or civic engagement (Ito, Gutiérrez, Livingstone, Penuel, Rhodes, Salen, & Watkins, 2013). This new transformative approach takes advantage of the opportunities afforded to students who are operating in a constantly changing and 24/7 connected digital world. A key principle is that three critical spheres of learning are connected: academics' strengths, a learner's interests, and inspiring mentors/peers. In addition to this, the emerging digital innovations of new media and the connected age are exploited, and the concept that making and creating lead to deeper learning and understanding is deployed in classroom practice.

Connected learning encourages students to "experiment, to be hands-on, and to be active and entrepreneurial in their learning, recognising that this is what is now needed to be successful in work and in life," ("What is connected learning," 2014). As evidenced by Mewburn (2012), the design studio is a flexible model of teaching that can encompass a range of teaching and learning approaches. Design studio practice can indeed differ from Schön's model of 'coaching artistry' and embrace a range of different and less traditional configurations.

*Emerging Architectural Learning Environment Design and New Pedagogical Approaches*

Considering the contextual issues discussed above, a significant issue arising is how to forecast the design of future learning environments for architectural education. In the past this area of research attracted interest, for example Schön in 1983, however, little recent research has specifically addressed the evolving physical and pedagogical design of architectural studio learning environments which are the primary conduit of architectural education.

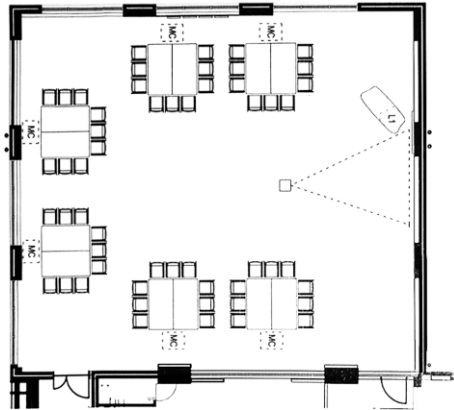
This chapter describes two recent studies conducted at a major Australian University. These studies had two major purposes: to identify the emerging trends in the design of future learning environments for architectural education in Australia; and to understand and describe spaces in which students of architecture are likely to learn in the future. The research explored the important linkages between space, technology, pedagogy and context using a multi-methodological qualitative research approach. By understanding and aligning these emerging trends with current dynamic technological, social and global changes in how architects are now practicing architecture, this chapter suggests a new pedagogy, exploring how students of architecture are likely to learn in the future.

*Study 1: Technology Enabled Learning Spaces, SCALED-UP*

*Learning environment design, technology and pedagogical approaches.* In the first study, a new digital learning laboratory was designed and constructed as a prototype learning environment for a new Science and Technology Precinct and Community Hub. This space adapted Student-Centred Active Learning Environment for Undergraduate Programs (SCALE-UP) principles and sought to address the specific requirements of the various case study users. SCALE-UP learning environments are designed to support a studio-style pedagogical approach and promote the facilitation of desired interactions between students. The environment is purposefully designed to be a “highly collaborative, hands-on, computer-rich, interactive learning environment for large-enrolment courses” (Beichner & Saul, 2003, p. 01). Classes are designed to include hands-on activities, simulations and role-playing, and student learning is primarily hypothesis or problem-based learning driven. Students are required to sit in three groups of three students at separate tables, whilst teachers circulate the room, engaging with teams or individuals, as the need arises (Beichner & Saul, 2003).

The design requirements for the prototype space varied extensively, as it was designed to be used by a variety of different stakeholders, including those from science, the humanities, business and design. In advance of the construction, the architects and planning team consulted the users of the nominated case-study, to ensure that all envisioned pedagogical and curriculum needs were addressed and accommodated for in the proposed design. Due to the diversity of requirements and

time and budgetary restrictions, a ‘best-case’ design scenario was agreed upon and signed off for construction.



*Figure 1. Floor plan and photograph of study 1 learning environment  
Photo credit: Lindy Osborne*

The arrangement of space allowed for 54 students working in six distinct group work zones, a central open space, a semi-mobile media equipped lecture podium and a laptop garage which contained 10 laptops, six USB document cameras and two mobile teaching headsets. Each of the six group work zones consisted of two mobile tables, nine mobile chairs and one large mobile computer. The work zones were each orientated to face an outside wall. Sufficient power outlets were provided in floor boxes to allow all students access if required.

In addition to Wi-Fi access, the mobile computers were loaded with the following web-based software to help to facilitate a digitally collaborative learning



environment: Skype (video calling and instant messaging application, with mobile device integration); Advanced Video Conferencing (EVO) (video conferencing tool that facilitates online meetings for up to 16 participants); Net Support School (class-room management application, to allow central control all class computers); Open Web Lecture (OWL) (student response system facilitated through mobile devices); Google Docs and Mindmeister (applications for collaborative ‘real time’ creation, editing and sharing of documents/mind-maps); and Social Media (social utilities that connect users).

*Data collection and analysis.* 165 second year architecture students self-allocated into two different design studios. 70% of the students chose to continue working in their traditional design studio environment and the other 30% chose to participate in this study, which involved taking their classes in the new prototype SCALE-UP learning environment. All the architecture students attended the same information sessions, followed the same studio curriculum and completed the same pieces of assessment; the only significant differences were the allocation of teaching support staff and the physical environments within which the studios were conducted.

At the end of the semester, the teaching support staff and students completed a questionnaire about their experiences of teaching or learning, in their respective learning environment. The questionnaire responses reflected data from 100% of the 10 teaching staff and over 70% of the student cohort. In addition to the questionnaire, the teaching support staff and students were also invited to attend focus groups where a synergistic approach allowed participants to clarify and expand upon their experiences of teaching or learning architectural design within the traditional and/or new experimental settings.

Using a mixed methodology of thematic analysis and grounded theory, the questionnaire and survey data were coded, extrapolated, compared, contrasted and finally merged, to reveal six distinct emerging themes which were instrumental in causing resistance or influencing adaptation to the new SCALE-UP learning environment (Osborne et al., 2011).

### *Study 2: New Studio Spaces, Based on Designs from Study 1*

*Learning environment design, technology and pedagogical approaches.* Following the completion of Study 1, the traditional architectural design studios were redesigned and renovated taking cues from the lessons learned in the first study and again adapting SCALE-UP design principles. These were the studios in which the ‘other’ 70% of students in Study 1 had originally chosen to learn. The renovations, however, were also required to respond to the heritage protected requirements of the building and a more limited budget, so not all “ideals” could be incorporated because of these limitations. Similar to Study 1, the renovations included modifications to the spatial environment (limited because of the aforementioned



heritage protection of the building) and the addition of new technologies and furniture provided within these spaces.



*Figure 2. Photographs of study 2 learning environments  
Photo credit: Lindy Osborne*

The spatial changes included the somewhat bold decision to merge six smaller, separate studios into four larger combined studio spaces through the demolition of internal dividing partitions. By further opening up these spaces it was believed that new pedagogical opportunities, for example team and larger class teaching, could be explored and facilitated. The total occupancy capacity of the combined studio spaces was 108 students: 18 students in each of the two smaller studios and 36 students in each of the two larger studios. In addition to the studio space reconfiguration, old carpets were removed to reveal the original heritage listed timber floorboards.

Technology additions included six new fixed data projectors and screens (one per 18 students), 12 new large mobile computers (one per nine students), and multiple mobile pin-boards and whiteboards. While not as prescriptive as Study 1, the spatial layout and arrangement of each designated studio space was intended to consist of distinct group work zones around an open central space, supported by a data projector and screen, and the mobile computers. The new furniture selected included large white tables and chairs that were both mobile and stackable. These tables were configured in sets of two to seat groups of 9 students and were orientated to face the outside wall like those in Study 1. In addition to Wi-Fi access, the mobile computers hosted software to provide scaffolding to the collaborative learning environment, although this was not as sophisticated as the software provisions of Study 1. Software included: Skype; Google Docs and Mindmeister; and Social Media.

Like in Study 1, it was intended that teachers would take advantage of SCALE-UP principles when utilising these spaces. As architectural design studios were mainly taught in these spaces, a studio-style pedagogical approach was almost universally implemented. This included student driven hands-on learning by making or drawing activities, role playing and problem based learning. Many of these activities were enacted collaboratively while the teacher moved around the classroom to check on the progress of individuals or groups and provide helpful disruption, where required. The new environment and embedded technology helped to facilitate a highly collaborative and interactive learning environment with important web connectivity for information sourcing or sharing.

*Data collection and analysis.* During Study 1, 79 second-year architecture students (approximately 70% of the students) completed a questionnaire about their learning experiences in the traditional architectural design studios. Study 2 was expanded to include questionnaire responses from 356 students from all five years of the undergraduate and the masters courses; approximately 40% of all enrolled architecture students. These students had all experienced learning in the newly renovated architectural design studios, prior to completing the Study 2 questionnaire.

Again, using a dual method qualitative approach, the questionnaire data were coded and extrapolated using both thematic analysis and grounded theory methodology. The results from these two studies across two consecutive years were compared, contrasted and combined to reveal five distinct emerging thematic

areas that were instrumental in influencing adaptation to the newly renovated architectural design studio learning environments. These five thematic areas highlighted the important linkages between Space, Pedagogy and Technology in supporting the students' overall learning experience (Osborne, Franz, Savage & Crowther, 2012).

## FINDINGS

The results of these two studies were, in some ways, surprising. A key over-riding theme was the strong resistance by students when adapting to learning in the new high technology-embedded learning environments. However, notwithstanding the surprising extent of this resistance, three quarters of the students agreed that their overall learning experience in the newly renovated studios had been positively enhanced, despite the perceived disruptions. Other key themes were the importance of the learning spaces, furniture, and technologies in the design of the physical environment required to support effective blended student learning.

### *Resistance in Adaptation*

Six distinct themes that address proficiency, support and compatibility and which were instrumental in offering resistance or influencing adaptation to the newly renovated, high technology-embedded learning environments were identified by Osborne et al. (2011), and are summarised below:

- *Technical/technological proficiency*: Training with respect the use of the new technologies and equipment must be supplied for teachers and teaching support staff; this knowledge can then be passed on to students.
- *Technological infrastructure support*: The provision of generic technological equipment and software can provide limitations when there is a large range of different users with specialised requirements, sharing the same facilities.
- *Human infrastructure support*: Institutions should consider appointing a dedicated person to support the specific technology and learning environment needs.
- *Pedagogy/technology compatibility*: In a design studio, digital technologies support the research, collaboration and presentation stages of the design process, however they can provide limitations too, especially when the users are lacking in skills and competence.
- *Pedagogy/technology/environmental compatibility*: While SCALE-UP learning environments support self-directed and collaborative group work, it is still important to retain some elements that support traditional design education.
- *Pedagogy/environmental compatibility*: The relationship between amenity and learning is of significance: the physical size, cleanliness and perceptions of value invested in the space, for example furnishings, may impact on how a student engages with their learning.

*Spatial Elements, Technology and Furniture*

While there was a generally positive response to the improved amenity of the renovated learning environments, some issues arose as a result of the changes. The two studies resulted in five distinct thematic issues which centred around spatial elements, new and traditional technologies and the impact of furniture selection embedded within these spaces (Osborne et al., 2012). These issues are summarised thematically, below:

1. *Social learning spaces*: Over 90% of students responded positively to the addition of more social and informal learning spaces to the campus environment. When asked where their favourite space to work was, the students' first preference was the architectural design studios, and following these, students nominated various alternative social spaces such as the collaborative and informal breakout spaces in the campus library, coffee shops, and the unstructured design student common rooms. In all these spaces learning is self-managed and, with the simple addition of Wi-Fi access and mobile technologies, students can easily access online resources, share information and collaborate without the intervention of a teacher.
2. *Sensory (dis)abilities*: Two sensory items were identified as potential barriers to learning in the new high technology-embedded environments – acoustics and vision. The elimination of the internal dividing partitions to provide a larger and more flexible space, in combination with the removal of the carpeted floor finish negatively impacted the acoustic properties of the space. Students reported difficulty in hearing as a result of peripheral noise, which impacted on their ability to concentrate and learn. Students' vision was also negatively impacted – spaces were redesigned to eliminate the notions of a 'front' or 'back' of the classroom, but rather provide a more equitable collaborative learning experience. However, reliance on using technology (mobile computers) to demonstrate ideas or explain concepts was problematic for some students who reported not being able to see properly. Cultural conditioning leads students to believe that effective learning occurs best in a quiet and small, enclosed space – this is an important issue that must be addressed when teaching in large open plan collaborative spaces.
3. *New Technologies*: The introduction of new technologies, including data projectors, and mobile computers, was one of the most significant changes to the redesign of the architectural studios. The data showed a notable increase in students' beliefs that technology improved their learning; just over one third of students believing this in Study 1, increasing to nearly two thirds, in Study 2. The introduction of new technologies allowed more flexibility with how student project work was presented and shared. This is of particular importance during the student 'crit'- a signature pedagogy of design studios. Students believed that the introduction of new technologies had a positive impact on and assisted them with, group-work, collaboration, sharing and communication of their ideas.

4. *Traditional Technologies*: A trend that emerged across the two studies was how quickly students moved away from their reliance on pin-boards and whiteboards, to become more comfortable using new technologies to display their work. The study indicated a 10% increase in students bringing their own mobile devices to class, and a 33% reduction in their reliance on pin-boards and whiteboards. Junior students generally learn to draw by hand, but as their skills and confidence build they transition to working in a more digital domain, including both Computer Aided Design drawings and digital scans of freehand conceptual sketches. Teaching staff often insist on printed copies of drawings for a ‘crit’ pin-up, to allow the work to be viewed as a whole rather than consecutive series of images shown through a digital medium.
5. *Furniture*: A significant component of the design studio renovation was for all furniture to be mobile and stackable to allow users to take ownership of the space and easily transform it to suit their pedagogical needs. A further requirement was to provide large-scale tables with white surfaces to allow for production and display of architectural drawings. 80% of the students described the positive impact that the new furniture had on supporting collaborative learning – a signature pedagogy of the design studio.

## CONCLUSION

When planning the design of new or significantly modified learning environments, it is essential to approach this task through multiple lenses. Consideration must be given to the spatial, technological, and social and pedagogical contexts within which learning take place, as each of these has an impact on student engagement, attitude, and ultimately achievement. While focus tends to be given to the design of physical spaces and places for teaching, it is also important to consider learning that occurs in virtual and informal environments, both on and off campus, and to understand how key components of these can be positively supported in considered design of space.

### *Spatial Context*

The relationship between amenity and learning is of significance: the physical size, cleanliness and perceptions of value invested in the space may impact on how a student engages with their learning. When designing open-plan and collaborative design studio environments, careful consideration must be given to the implications that they have on students’ ability to hear and see effectively. While some of these issues may be simply attributed to cultural conditioning when adapting to a new environment, if a student cannot hear or see effectively, learning may well be diminished. Flexibility and appropriateness of furniture selected is important, and consideration should also be given to the amount of furniture provided, particularly if varying pedagogical modes of learning may take place, in the same space.

Where time allows, it is beneficial to trial different types of furniture and collate feedback from the users prior to expending large amounts of funds on what may well become redundant selections.

### *Technological Context*

While there is still a romantic yearning for the placement of old technologies in architecture design studio learning environments, there is evidence of a swing away from these, and towards the use of new, digital technologies. It is also evident, however, that the new cannot simply replace the old, and that the provision of blended old and new technologies appears to be most successful solution at this stage, while student and lecturer confidence/competence, is built. Transitioning to learning and teaching in high technology embedded learning environments can be problematic at first, and must be supported by a number of factors. Teachers need ongoing training to use new technologies and equipment, and regular maintenance of the equipment is required. Institutions should consider appointing a dedicated person to support technology and learning environment needs. Rather than attempting to satisfy all users with establishing generic spaces, it is advisable to provide discipline or faculty specific environments, where specialised technological requirements can be satisfied.

### *Social and Pedagogical Context*

Student desire for more social and informal learning environments is clearly evident. While it is not appropriate to simply abandon the traditional teacher-centred learning environments that still have their place in university education, there are some components of informal or social learning pedagogical approaches that may well be introduced in learner-centred collaborative blended learning environments. Teachers must not rely on digital technologies alone, especially when teaching junior design students. While technologies support the research, collaboration and presentation stages of the design process, they have limitations. It is important to maintain a blended approach, and to maintain the importance of hand drawing/modelling and representation ideas. For the time being at least, it is still important to retain some elements that support traditional design education, for example the provision of pin-boards, drafting tables, light tables and physical model making equipment.

While the results of this overall study are somewhat varied and indicate both areas in need of improvement and areas which have been improved, arguably the most important results from this study indicated that students believed that their overall learning experience had been positively enhanced as a result of the renovations of the architectural design studio learning environments. Having three quarters of students state they had a positive overall learning experience in the renovated studios confirmed the importance of the design of the physical



environment in supporting blended student learning. This is significant as we transition towards more teaching and learning in blended and online environments.

#### IMPLICATIONS FOR TEACHERS AND DESIGNERS

Design studios exemplify active and connected learning environments. They support dynamic, project-based, collaborative and connected learning models. While the studies in this chapter took place in an architectural design studio setting, it is anticipated that the implications of this research may well have a positive impact beyond the confines of design education, as many similar settings also exist outside of the design studio. The findings are not only significant in alternative higher education settings, for example the arts or humanities, but arguably they may also be of benefit in secondary and primary education settings, where similar approaches are being experimented with.

Architectural practice is undergoing significant change globally, and architectural education needs to keep abreast of these changes. Access to new technology and the development of specialised architectural documentation software including BIM (Building Information Modelling), has scaffolded new building procurement methods and allowed consultant teams to work more collaboratively, efficiently and across different time zones.

As most architectural design and technology studios are based on the design and documentation of buildings using a traditional procurement method, and because of rigorous university architecture course accreditation requirements in Australia, unless they have a part time position working in an architectural office, it is difficult for students to have an authentic ‘real-world’ collaborative learning experience whilst they are studying at university.

It is no longer acceptable for today’s design studio to consist merely of banks of desks and chairs with pin-boards and whiteboards or chalkboards. While students still create paper and cardboard working models by hand to explore form as a part of their design process, because many are modelling their designs using BIM or similar computer software, they are able to produce a high end and realistic scaled 3D physical models with relative ease at the end of the design process. As a minimum standard therefore, architectural design studios in Australia need access to workshop facilities to assist students in making 3D models. In addition to this, many students now create animations, fly-throughs and/or animated movies of their design proposals – all of which can only be submitted and viewed in digital format. Studios therefore need access to mobile computers, data projectors and image projectors as a minimum.

It is not possible to effectively keep operating design studios the same way that they have for the past two hundred years given the injection of high-end technology and personal mobile Wi-Fi enabled devices. Pedagogical approaches and learning styles have to adapt to these new opportunities for virtual design and collaboration environments for education.



## ACKNOWLEDGMENTS

The author gratefully acknowledges the feedback provided by Queensland University of Technology's architecture students who participated in this study, and the ongoing support and contribution provided by her PhD Supervisors, Professor Jill Franz, Professor Sue Savage and Associate Professor Philip Crowther.

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## **5. ARCHITECTS AS AGENTS FOR ORGANISATIONAL CHANGE IN NEW GENERATION LEARNING SPACES**

### CONTEXT

Space, technology and pedagogy are often heralded as the key influences in the development of New Generation Learning Spaces (NGLS's) (Radcliffe, Wilson, Powell, & Tibbetts, 2008). The successful utilisation of these spaces and the introduction of new teaching and learning practices is not, however, a guaranteed outcome of a process that only focuses upon the physical aspects of NGLS design.

As an architect working in the field of education space design, my observations of recent school expansion projects where new generation learning theories were being explored, reveal that the critical factors for successful implementation of new pedagogies are at least as reliant upon space and technology design as on the presence of both a holistic approach to architectural design and the leadership of aligned organisational change.

When designing new spaces, architects are perfectly positioned to explore organisational issues that need to be addressed as part of the transformation of a teaching and learning community, and yet historically they typically focus on the space being designed (making allowance for the integration of technology).

This chapter explores how a minor expansion of traditional architectural practice through the application of design thinking can assist school communities to improve their chances of successful transformation from traditional teaching and learning models to those that fully take advantage of new generation learning spaces.

### OBJECTIVE

#### *The Relevance of Design Thinking to New Generation Learning Space Design*

Design thinking seeks to transpose the processes undertaken in traditional design professions (such as architecture and engineering) into other areas of enquiry and the theory has been eagerly applied to the fields of Information Technology (Brooks Jr, 2010) and business management (Martin, 2009). However there is a growing sense that a design approach may also have significant benefit in any area of human endeavour where there are open-ended and complex problems to be solved.

Traditional problem solving seeks to manipulate a limited number of known variables to achieve a desired result (Dorst, 2011). A design thinking approach understands that there are many variables that may impact upon an outcome, some known and appreciated at the commencement of a design process, with others that are not clearly linked but which may nevertheless have a significant impact upon its success. Being open to the existence of new information can assist in the progression towards an aspired outcome.

In order to understand how this approach may add value in the current context, it is important to understand the core logic behind the way in which designers approach problems. Dorst describes standard problem solving as utilising the following simple equation:

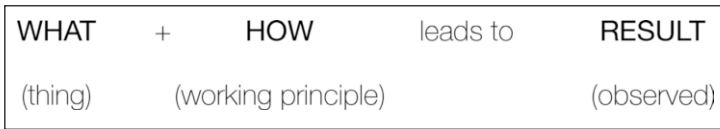


Figure 1. Traditional problem solving process (Adapted from Dorst, 2011, p. 523)

In traditional approaches to problem solving, *deduction*, identifies the ‘what’ in Figure 1; and, *induction* identifies the ‘how’ in Figure 1, to arrive at a somewhat logical result. In design thinking, these factors assist us to manipulate the knowns and unknowns towards a result, or *abduction*, where the desired RESULT creates a third factor – value for others. Thus, in design thinking, the equation is recast as:

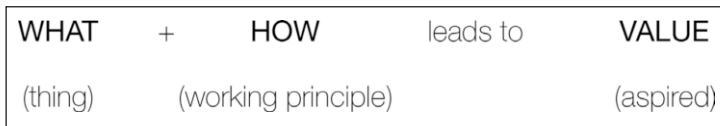


Figure 2. Design thinking process (Adapted from Dorst, 2011, p. 523)

In the unique situation of the design and inhabitation of a new school environment, this chapter argues Dorst’s (2011) abduction can be recast as *abduction II*, providing a theoretical framework for a successful educational design project outcome. In this instance, the equation can be suggested to be:



Figure 3. Design thinking remodelled for NGLs (Adapted from Dorst, 2011, p. 523)

In this approach, we understand what aspired value we are attempting to achieve (the successful implementation of new pedagogies linked to new generation learning spaces) but we do not know what to create, nor the working principle requiring application to enable the creation to achieve success. This approach acknowledges the open-ended nature of the problem to be solved and means that we must seek two unknowns in parallel, often leading to practices that are quite separate from traditional problem solving.

This latter approach, the ‘design thinking’ lens as applied to school space design, utilises those undefinable values inherent to school design and use, to facilitate a unique architect/school leadership partnership. This approach addresses the unknowns of NGLs. More than 30 years ago, Argyris and Schon (as cited in Mulford, 2005) understood the complex nature of educational reform, noting that those seeking to intervene in an organisation “have had to recognize that their main challenge is not to help an organization become more effective at the performance of a stable task in the light of stable purposes, but rather to help an organization restructure its purposes and redefine its task in the face of a changing environment” (p. 617).

This chapter contends that the standard approach to the design of new generation learning spaces misses an opportunity to expand architects’ natural design thinking processes. These processes could be used to assist school communities to ensure successful change-management is aligned with the development of new facilities.

If architects can become the design thinker in an interdisciplinary environment – that is, having empathy and understanding for people and for disciplines ‘beyond one’s own’ (Brown & Wyatt, 2010) – then the disparate and complex issues that contribute to successful educational project outcomes can be more comprehensively addressed. Brown and Wyatt (2010) also note that there are impediments to the successful adoption of a design thinking approach. These include an organisation’s wariness of the theory and processes involved, resistance to a human-centred approach, or an inability to properly balance the disparate perspectives of users, technology and the organisation as a whole.

Although some of these impediments are less likely to arise in school settings because of the nature of the work undertaken within the ‘organisation’ (that is, the teaching of students, an inherently human-centred activity), there are still risks that the process will meet resistance on an organisational level because of entrenched views. The idea, for example, that an architect should be cognisant of, and actively interested in, the broader educational and organisational settings within which a design project is being undertaken may be viewed with scepticism, especially when some of the ideas being discussed during early design meetings challenge existing practices and philosophies.

Experience gained through professional architectural practice has highlighted that regardless of the skill, knowledge or intention of an architect applying a design

thinking strategy to a new education design project, there are other significant factors that affect the success of the project outcome. It is the ability of architects to be aware of, and open to, these factors that could assist in linking successful pedagogical outcomes with NGLS design.

Two case studies are provided to highlight these factors.

#### *Case Study 1 – NSW Regional Catholic High School*

The new Principal of this established regional Catholic high school inherited a school in which a number of new buildings had been designed and constructed within the previous 10-year period. He was keen to plan for the next 10–15 years and had entreated the Catholic Education Office to undertake a new master planning process, for which an architect had been engaged.

Site visits revealed a campus with a strong organising principle (i.e. ‘School Street’) along with some flexible learning spaces that appeared not to be being utilised in the way they were intended. Subsequent meetings with the staff cohort revealed a general dissatisfaction with the most open and flexible of the spaces – a modern, light filled open planned teaching and learning area. The space was seen as being ‘too noisy’ and ‘too open’ and was often transformed through the placement of screens and furniture in an attempt to create more traditional classroom areas.

The staff area of the school was arranged such that each staff member had an allocated permanent desk and shelf unit that over time had developed into accumulations of resources that were closely guarded and intensely private. Resource rooms revealed compactus units stacked with old VCR tapes and other out-of-date resources.

When questioned, staff acknowledged having been interviewed by the previous design architect of the open learning space with a view to having their ideas integrated into the design. When pressed, they acknowledged that there had been no additional support or professional development relating to new teaching practices that could be employed within the newly designed space.

Discussions arising from the new master plan process revealed the new Principal’s strong desire to address these issues. However, it was acknowledged that the previously poorly managed introduction of the unconventional spaces may have damaged teachers’ willingness to consider challenges to their existing philosophical approaches. Exploration of alternative staff arrangements and new pedagogies would therefore need to recognise these sensitivities.

#### *Case Study 2 – ACT Public Primary School*

The new Principal of this public primary school had been looking for an opportunity to apply her research into Professional Learning Communities (PLC’s). The commencement of her tenure at the school coincided with a Government funded expansion of the school from a three-stream (three classrooms per year group) to

a four-stream school. The Principal saw the opportunity to integrate PLC concepts into the design process and worked closely with the architect of the expansion project to ensure that staff areas and classrooms would support new approaches in both teaching and learning.

The Principal involved a core group of senior staff in espousing the PLC vision, although not all were supportive of the mooted changes to established practices. Through an extremely intense period of design, supported by a research based education process of the staff, a complete shift in work practice was achieved. Staff who were formerly isolated in year group enclaves were brought together through the design of a collaborative staff work area. Professional conversation was encouraged. Teaching practices were advanced to enable the opportunities afforded by the newly designed flexible learning areas to be taken advantage of. Subsequent evaluation of staff attitude revealed an almost unanimous consensus that the new arrangements were beneficial.

#### FINDINGS/RESULTS

Despite the differences in settings, project brief and stage of development, the two examples cited reinforced other practice-based observations that formed the core of an anticipated research direction. In essence this entails determining critical factors that affect the ability of a school to successfully implement a change in its pedagogical framework concurrent with the design of new teaching and learning spaces. This appears to be reliant on two factors being present alongside a holistic or design thinking architectural design approach: strong leadership and a commitment to teacher development. If the links can be shown, then it is contended that the consideration of these two (non-design) factors as part of the design process may assist in linking desired pedagogical outcomes with NGLS projects.

##### *Strong Leadership*

More than 20 years ago, the dilemma facing schools in an era of continuous renewal was highlighted (Fullan, 1993). Fullan argued that teacher training, educational hierarchies and political and policy environments tended to be systems that retained the status quo and he called upon educators in the field to act as agents for change to break the impasse.

10 years on, emphasis on leadership as being key to large-scale, sustainable education reform was reinforced (Fullan, 2002). In his paper 'The Change Leader', Fullan argued that the school principal of the future – the Cultural Change Principal – would be a critical component of sustainable change in a knowledge society. In his view, the concept of 'change management', a term usually associated with business management, was also relevant in an educational setting.

He listed five essential components that characterised leaders in a knowledge society:



- demonstrating social responsibility to others and the environment
- having an understanding of the change process
- possessing the ability to improve relationships
- being capable of transforming information into knowledge through a *social* process, and
- the ability to facilitate understanding within an environment of information overload.

Fullan suggested that a Cultural Change Principal worked to embody these principles, resisting the temptation to drive an individual agenda within an environment hostile to change.

A Principal alone cannot carry the entire load of responsibility for organisational change, and most schools are characterised by a combination of formal and informal leadership (MacNeill, Cavanagh, & Silcox, 2003). Principals' transformational leadership practices have been established as being directly or indirectly influential upon a wide range of school variables (Silins, Mulford, & Zarins, 2002).

In Case Study 1, there had been an apparent lack of leadership in relation to changing pedagogies and during the introduction of new generation learning spaces to the teacher cohort. This resulted in little opportunity for teachers to understand the benefits of questioning their existing philosophies. Unsurprisingly, then, the motivation to adapt their practices to spaces that were perceived to be hostile to traditional teaching methods was low, and resentment for being forced into unfamiliar physical arrangements was commonplace. The new Principal was acutely aware of the role required of him in guiding discussion on issues that were challenging to his teacher cohort to enable reflection upon new pedagogies.

In Case Study 2, the Principal worked tirelessly to ensure that the changes she wished to introduce to the school were clear and backed by research findings. The changes were carefully planned, programmed and strategized and were undertaken within a corporate change-management framework. She created a small executive team to assist her to sell the messages throughout the school community. The team consisted of experienced teachers and the school business manager, noted in Hargreaves (as cited in MacNeill et al., 2003) as a "vital agent for creating the conditions in which school reform can succeed" (p. 6).

In post-construction discussions, the Principal admitted that the path to success was extremely challenging. However, commitment to the principles of Professional Learning Communities, a willingness to discuss queries within a research-based response framework, and an expectation and management of resistance were all critical factors in the success of the programme's introduction. Considering the possibility of facing resistance at the outset of a change programme is said to have a critical impact on its success (Zimmerman, 2006).

The understanding that the design process can be used as a reinforcement of the principles being pursued was also key to the change-management success in Case

Study 2. Early discussions on the design of the new staff area were used to ensure that the space and facilities provided were aligned with the desired organisational outcome. In this case, the drawing together of all staff into a central gathering space, the reduction of teacher owned resources and the provision of expansive kitchen facilities were all integrated into the design. Furniture selection (in particular large group tables for year group teachers) also played a role in the design/outcome (aspired value) nexus.

Case Study 2 demonstrates the critical role of ‘The Change Leader’ in the implementation of cultural/organisational/pedagogical change within a school, and how design can be leveraged to facilitate it.

### *Commitment to Teacher Development*

New school space design focusing on enabling a decentralised student-centred learning model and the integration and use of new technologies can confront the fundamental beliefs of teachers and require them to modify their practices to adapt (Ertmer, 2005). Pedagogical shifts with an emphasis on student-centred learning necessarily require teachers to view and understand course content as a complex web of opportunity accessible to a diverse student cohort. It has been understood for many years that the methods by which teachers can acquire these new skills cannot be developed using standard or traditional ‘teacher training’ strategies (Darling-Hammond & McLaughlin, 1995).

Knuth and Banks’ Essential Leadership Model (Knuth & Banks, 2006) seeks to identify the elements of leadership knowledge, skills and dispositions required to effectively organise, prioritise and manage change within a school community, noting the importance of focusing on both student learning *and* staff professional growth.

However, supporting and facilitating these changes are known to be less familiar to staff developers who are more used to developing programs that address ‘first-order’ change (e.g. training courses in the use of new technology) (Garet, Porter, Desimone, Birman, & Yoon, 2001). Instead, they require the development of a *culture* that provides opportunity for teachers to critically reflect upon their practice and to be able to integrate new knowledge and beliefs about content, pedagogy and learners. The problem, as defined by Elmore (as cited in Fullan, 2006) is that:

...there is almost no opportunity for teachers to engage in continuous and sustained learning about their practice in the settings in which they actually work, observing and being observed by their colleagues in their own classrooms and classrooms of other teachers in other schools confronting similar problems of practice. This disconnect between the requirements of learning to teach well and the structure of teachers’ work life is fatal to any sustained process of instructional improvement. (p. 11)

In this context, the belief that newly designed spaces for teaching and learning in and of themselves can lead to shifts in teaching practice (and learning outcomes) can be dismissed. However, if the organisational and pedagogical changes that are required to facilitate shifts in teacher practice can be recognised and interwoven into the design process for new spaces, then design can be used as an agent for 'second-order' change.

In Case Study 1, the teacher cohort confirmed that as part of the design process for the recent new facilities there had been no professional development that encouraged them to consider the possibilities for new teaching and learning systems in either pedagogical or methodological terms. Staff were hostile to the new spaces and dismissive of the process that resulted in new rooms that were considered 'unworkable'.

In Case Study 2, the Principal programmed a range of professional development activities, including site visits to demonstration NGLS schools and guided discussions between staff during the design process. Staff overcame their initial resistance to changes in practice and are now universally accepting of the new pedagogical framework and are willingly learning to implement it within the new spaces.

## CONCLUSIONS

These two disparate cases support the claim that, for the design of new teaching and learning areas to successfully allow the introduction of new constructivist pedagogies, the design process must be undertaken within the context of an aligned cultural and organisational change.

To further test if this belief is broadly applicable, it is suggested that a range of educational projects with an NGLS focus be audited, post completion, to determine the following:

- To what extent were the designing architects cognisant of and involved with the parallel processes of organisational change within the broader school community in the transition to new pedagogies offered by the newly designed facilities?
- Was there a leadership strategy in place prior to the commencement of the design process, and if so, what form did it take?
- Was a regime of professional development for teachers, and more broadly, consultation with other stakeholders (students, parents, community groups) put in place as part of the design process, and was the architect involved as a part of this regime?
- Have there been observable changes in teaching and learning practices afforded by the new spaces?
- To what extent have the teaching philosophies of school staff (across all levels) altered as a consequence of this process?

## IMPLICATIONS FOR TEACHERS AND DESIGNERS

Most stakeholders in a new school design project commence with excellent intentions and high hopes for success. Siloed thinking on both sides of the design equation can interfere with that success.

If future research supports the observations noted in this chapter, then it may form the basis for the development of tools for both designers and educators to improve the opportunities for successful transition to new pedagogies through the design of new teaching and learning spaces. For example, it may be possible, with the assistance of school policy advisers and professional development providers, to develop pre-design checklists to assist schools to ensure that the design process is undertaken within an aligned organisational change framework.

Furthermore, it may be possible to develop specific tools for designers to guide their briefing and design processes to ensure that full recognition is being given to the broader social and organisational framework within which the project is being undertaken.

Research into ways in which the design process can assist in delivering successful teaching and learning outcomes within the rapidly changing education landscape is critical.

Education facility planners and designers are not educators, but they need to understand education. They cannot drive change, but they must know how to facilitate it.

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## 6. WORKING TOGETHER IN THE SPACE-BETWEEN

*Pedagogy, Learning Environment and Teacher Collaboration*

### INTRODUCTION

For teachers, the arrival of new generation learning environments (NGLEs) may offer the chance to do something that the predominant built infrastructure has discouraged – the opportunity to work together. Learning environment designs that deliberately group teachers, students and learning settings together signal a spatially inbuilt intentionality for teacher collaboration.

However as Blackmore, Bateman, Loughlin, O’Mara, and Aranda (2011) note, learning environment research has often focused on the design phase rather than on ongoing occupation. As a result there remains an aspirational tone that frequently runs through the design literature, often making the assumption that changes in teaching and learning will occur as a result of new spaces. Consequently researchers and evaluators have called for a better understanding of the way that teachers occupy space, their pedagogical approaches, and the resulting impact on learning. In essence, ‘what works?’

The same question also needs to be asked of collaborative teaching spaces. There is a need for a better understanding of the way teachers occupy space *together*, what pedagogical practices are used and with what impact? This space-between pedagogy, learning environments and teacher collaboration therefore forms the heart of this emerging theme. ‘What works’ *together*?

### *New Space – New Opportunities?*

In New Zealand these are timely questions. The development of Modern Learning Environments (MLE)<sup>1</sup> in the primary school context has followed a global shift in thinking about the relationship between pedagogy and space. It has been accelerated as a consequence of the recent requirement for considerable investment in educational property (Ministry of Education, 2011). This need for extensive school building and refurbishment was caused not only by Christchurch’s earthquakes in 2010 and 2011 but also by considerable urban growth and a wave of ‘leaky’ school classrooms in need of major refurbishment or replacement. Of the NGLE designs that have emerged recently, many are based on the concept of a group of teachers co-habiting

a learning space. Instead of working in isolation, groups of two, three, four or more teachers work collaboratively to design learning and teaching for a larger group of students.

Why collaborative teacher spaces? Much of the thinking stems from a need for learning environments to more closely align with the predominant shift from teacher-centred to student-centred practices. As frequently acknowledged, new generation learning environments present opportunities to realign the ‘built pedagogy’ with contemporary models of learning and teaching (Blackmore et al., 2011; Fisher, 2005; Heppell, Chapman, Millwood, Constable, & Furness, 2004; Lippman, 2010b; Nair, Fielding, & Lackney, 2009). Designing spaces that co-locate teachers potentially offers: first, the ability for teachers to collaboratively plan, work together and share professional development; second, the opportunity for a team approach to lead towards varying pedagogical alternatives; and third, the idea that a team of teachers can better meet the needs of particular groups of students, so that each may receive more attention than when taught by a single teacher (OECD, 2013). Such spaces potentially privilege affordances of student agency, personalisation and democratisation that are now seen as critical to understandings of contemporary learning practice (Deed, Lesko, & Lovejoy, 2014). This contrasts with the control and rigidity that was symbolic of traditional classroom spaces. In making the case for teams of teachers working together, OECD suggests that it is not so much to “totally transform the organisation of learning so that it is unrecognisable, but to develop more complex, flexible arrangements that accommodate the demanding aims that learning environments are today striving to achieve” (p. 72).

In conceptualising school environments that aim to address the limited opportunities offered traditional single teacher ‘egg crate’ structures, the lingua franca of new generation learning spaces is often one of flexibility, mobility, and openness, seeking to break down the walls both physically and metaphorically, (Horne, 2004; Lee & Ward, 2013). Such spaces “conjure[s] themes of freedom, openness, personal realisation and creativity” (Barnett, 2011, p. 167). Importantly this stretches beyond the physical and material space to encompass the pedagogical and curriculum spaces too. The suggestion is that such spaces offer to “change students’ lives” (Barnett, 2011, p. 168).

Spatially the change of learning environments from classrooms into shared, open, collaboratively taught settings leads undoubtedly, to a re-scaling of space for both students and teachers. (Leander, Phillips, & Taylor, 2010; Nesper, 2004). These spaces may give rise to new levels of mobility (Leander et al., 2010), new proximities (Knoben & Oerlemans, 2006), and new pedagogical possibilities. But new space does not itself cause a shift in pedagogy (Alterator & Deed, 2013), although perhaps as Halpin (2007) observes, it may attract more progressively minded teachers.

Regardless of which teachers inhabit and inherit new learning spaces they will do so differently, according to their own perceived needs and those of their students (Barrett & Zhang, 2009). A move into a new space can therefore only be viewed as a ‘finished beginning’ and a starting point from which adaptations



that support successful learning can occur. Over time different teachers with different cohorts of students will move in and utilise the environment, creating modifications and adaptations to suit their needs. This cyclical changing reflects Thomson and Blackmore's (2006) suggestion that design is ultimately a process of 'serial redesign' reflecting school culture, organisation and the practices of both students and teachers.

For those who occupy new collaborative learning spaces, both teachers and students alike, it is ostensibly a generational treading into the 'terra incognita'. With the exception of those who are able to reflect on their experience of open-plan schools of the 1970s and 80s (Cleveland & Woodman, 2009), most primary school teachers' experience of teaching space will have been limited to traditional classroom settings.

But the reality of shared space brings with it multiple questions. What does teaching together look like? What models of team teaching are adopted? How are new spatial opportunities utilised by teams of teachers, and with what effect? What are the implications for teachers in terms of the work they do alone and the work they do with colleagues? How do teams of teachers develop models of constructing this? And ultimately, what are some of the new opportunities, new routines, and new pedagogies that emerge from the spatial possibilities engendered by this reorganisation of teachers?

Understanding what these complex, flexible and inherently collaborative arrangements might look like forms a key component of investigation. Understanding the way that teachers cohabit space, work together, teach together and the processes by which they do so successfully are therefore critical understandings.

### *A View of Space*

The recursive nature of geographical terminology in discussing learning spaces should perhaps not be a surprise. Replete with references that describe proximity, interrelationships, settings and spatiality, the use of such themes are frequently encountered in educational and learning space discourse (Sagan, 2011). There is perhaps a conceptual security in discussing learning environments in geographic terms. School places are familiar places.

However as critical social scientists have explored, space may be viewed as providing more than a physical backdrop for social action (Massey, 2005; McGregor, 2004). Instead, from this perspective, space is relational, created through interactions, and consequently, as McGregor (2004) notes, can be both made and remade. For Massey (2005) this recognition determines that space is inherently always under construction, it is "never finished; never closed" (p. 9), and that it might be imagined as a temporary arrangement at the nexus of the social and the spatial:

Rather, what is special about place is precisely that throwtogetherness, the unavoidable challenge of negotiating the here and now (itself drawing on a

history and geography of thens and theres); and a negotiation which must take place within and between both human and nonhuman. (Massey, 2005, p. 140)

Massey's conceptualisation of space as iterative and ever-changing is pertinent when it comes at looking at teachers in a shared teaching environment. Making the connection that space is about ongoing negotiations goes some way towards drawing together the 'messiness' of people in changing spatial arrangements. There is messiness about people working together (Gunter & Thomson, 2007), messiness about change (Bland, Hughes, & Willis, 2013; Schön, 1987), and messiness about learning (Sagan, 2011). There is messiness about socio-spatial relationships that mean component parts cannot be taken and transplanted elsewhere. What works well in one environment will not necessarily work well in another. As Dovey (2010) considers, all places are 'assemblages' each one consisting not simply of parts, but of complex interconnections between them.

Schools are already inherently complex places (Bissell, 2004; Nespor, 2004). So new learning spaces bring with them new spatial complexities (Campbell, Saltmarsh, Chapman, & Drew, 2013). Added to this, collaborative teaching situations bring different social affiliations and relationships. So too, teacher innovation and development of new pedagogical practices aligned with so-called '21st century' learning exists in both physical and digital domains (Oblinger, 2005).

Consequently, for a collaboratively taught learning space to be successful, for teacher relationships within them to reach levels of relational synergy (Bolam, McMahon, Stoll, Thomas, & Wallace, 2005; Ohlsson, 2013) that are a characteristic of deep collaboration, there are multiple elements to bring into alignment (Senge, 2006). Despite the acknowledgement that practices may be revisited and revised, in a process of "serial redesign" (Blackmore et al., 2011, p. 37), out of all the messiness and complexity, teachers need to make sense of the situation.

To borrow from Aoki (2003):

Here I recall teachers speak of their pedagogic struggles in the midst of the plannable and the unplannable, between the predictable and the unpredictable, between the prescriptible and the non-prescriptible. Their pedagogical where? – between the curriculum-as-plan and the live(d) curricula. Sites of living pedagogy? (p. 2)

For teachers shifting into new pedagogical landscapes, collaborative and open, there is sense of them occupying the ground somewhere between space-as-aspirational and the live(d) space. The opportunity provided by intertextuality illuminates the tension between possibilities and practicalities. But in doing so new 'white spaces' emerge (Cherry, 2005). As Cherry, notes "some of the most exciting and significant forms of creative and innovative effort emerge from the 'white spaces' between existing domains of knowledge" (p. 310). Snowden and Boone (2007) contend that complex contexts represent the domain of emergence. The 'white space' in question here is the space-between pedagogy, space and collaboration.

*Social and Spatial Implications*

If opening up walls and reimagining learning spaces have the potential to “change students’ lives” (Barnett, 2011, p. 168), then by creating collaborative teaching environments that encourage, or necessitate teachers working together, such spaces certainly change teachers’ lives. As McGregor (2003a) asserts, “space makes a difference” (p. 353). Accordingly many new generation learning spaces challenge socio-spatial aspects of teacher’s work and workplaces that hitherto, have been taken for granted (McGregor, 2003a). Teachers have generally worked in isolation with high levels of professional autonomy (DuFour, 2011; Elmore, 2012). Levels of visibility, privatisation, territorialisation (Campbell et al., 2013) and identity (Mulcahy, 2006) that have previously characterised the spaces teachers typically taught in, therefore become inherently more complex and contested in shared spaces (Deed et al., 2014).

The social aspects of new environments are responsible for part of the complexity. A greater number of teachers equates to a corresponding increased dynamic in relationships (Campbell et al., 2013; Saltmarsh, Chapman, Campbell, & Drew, 2014). Campbell et al. (2013) found that the larger numbers of students in collaborative primary school spaces called for different thinking around pedagogical grouping and organisation. In addition, the management of professional interactions add a second tier of relationships that in traditional settings had been kept spatially separate from the predominant teaching setting.

Hargreaves has long held that teaching is an emotional practice (Hargreaves, 1998; Hargreaves, 2001a, 2001b). His view of the ‘geographies’ of collegial interactions suggests that supports and threats to emotional bonds between colleagues can result from the “distance and closeness” (1998, p. 508) of physical, personal, cultural, moral, professional and political geographies. Teachers’ capacity to work together to solve problems therefore becomes a critical factor. Conflict, as Hargreaves (2001a) notes in his examination of collegial relationships, was the strongest negative emotion experienced between teachers in his study. It “was seen repeatedly as a problem, not an opportunity” (p. 524).

The spatial too, contributes to the complexity triggering a need for teachers to develop more of what Fisher (2004) terms a “spatial literacy” (Woolner, Clark, Laing, Thomas, & Tiplady, 2012). Teachers are in much closer physical proximity (Knoben & Oerlemans, 2006) to each other in shared, open environments, and therefore need to negotiate space, time, materials and authority (Alterator & Deed, 2013; Saltmarsh et al., 2014). The way that teachers consider notions of structure can be “pivotal to the spatial (un)responsiveness of pedagogical practices” (Saltmarsh et al., 2014, p. 12).

Alterator and Deed (2013) determined that on occupation of collaborative spaces teachers’ adaptability became an essential quality rather than the nice-to-have in a traditional setting. Flexibility in space and time translated into the need for a willingness to be adaptive to new situations and learning contexts. They noted

multiple factors involved in teacher adaptation. It is, “concerned with balancing individual versus neighbourhood space, individual versus social learning, physical versus virtual space, walled space versus transparency, closed versus open, pragmatism versus idealism, and control versus flexibility” (p. 11). Saltmarsh et al. (2014) found that more spatially responsive practices tended to be in evidence where emphasis was put on teachers and learners co-constructing use of space, rather than on more structured approaches such as timetables and routines.

### *Working Together*

The development of teams of teachers working together within schools is increasingly viewed as a solution to educational problems regarding quality of teaching, school improvement and outcomes of student learning (Cook & Friend, 1995; Datnow, Park, & Kennedy-Lewis, 2013; Forte & Flores, 2013; Hargreaves, 1994; Hattie, 2012; Johnson, 2003; Levine & Marcus, 2010). Teacher collaboration in Professional Learning Communities (PLC) is seen as having the potential to have a significant impact on student progress (Bolam et al., 2005; Hattie, 2012; Vescio, Ross, & Adams, 2008). Furthermore the concept of collective teacher efficacy suggests that the shared efficacy of a team of teachers is a strong predictor of student achievement (Eells, 2011; Goddard, Hoy, & Hoy, 2000; Tschannen-Moran & Hoy, 2001). However the overlap between the construct of professional learning communities, and the spatial practice of teachers teaching together, has not always been clear.

Enacted through a group of teachers “sharing and critically interrogating their practice in an ongoing, reflective, collaborative, inclusive, learning oriented, growth-promoting way” (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006, p. 223), the concept of Professional Learning Communities follows the hypothesis that “what teachers do together outside of the classroom can be as important as what they do inside” (Stoll et al., 2006, p. 224). In their work on effective professional learning communities Bolam et al. (2005), suggest that PLC exhibit eight key characteristics:

Shared values and vision; collective responsibility for pupils’ learning; collaboration focused on learning; individual and collective professional learning; reflective professional enquiry; openness, networks and partnerships; inclusive membership; mutual trust, respect and support. (Bolam et al., 2005, p. i)

Although, as Vescio et al. (2008) note, communities alter teachers’ approach to work, and represent a “fundamental shift in the habits of minds that teachers bring to their daily work in the classroom” (p. 84), teacher collaboration is noted as having traditionally happened ‘elsewhere’. Both temporally as well as geographically the work that teachers have done together has often been dislocated from the primary interface of teaching and learning. The faculty office, the staffroom, and the team meeting, have often formed the preferred sites for collaborative activities

(McGregor, 2003b). Often these arrangements have centred on communities of practice (Lave & Wenger, 1991; Wenger, 1998) that focus on sustaining current 'best practice' (Bull & Gilbert, 2012).

In reflecting that shifts towards systemic change required not only individual but also collective capacity building, Bull and Gilbert (2012) suggested that PLC, having change as their central tenant, as well as communities of practice, were critical as teachers explored new pedagogical practices in new generation learning spaces. New environments therefore potentially present opportunities for the development of new constructs of geographically in-situ professional learning communities resulting from de-privatised practice (Campbell et al., 2013). Some evidence of this in New Zealand was found in schools that had more open, shared teaching and learning spaces (Bull & Gilbert, 2012).

### *Collaborative Structures*

At this juncture there is a slight dislocation between concepts of collaboration and collaborative teaching arrangements within shared learning environments. Physical proximity does not by default translate into professional proximity. Teaching together, according to Hargreaves (2001a) who has written extensively on the subject of collaboration and school culture, "is reputed to be better than teaching apart" (p. 503), with collaboration typically being offered as the opposite of isolation (Hargreaves, 1994; Hatton, 1985; Horn, 2008; Johnson, 1990; Levine & Marcus, 2010; Little, 1990). However within the context of improved teaching and learning the relationship between teacher collaboration and outcomes is not linear. One does not necessarily lead to another (Crow & Ponder, 2000; Hargreaves, 1994; Hattie, 2012; Horn & Little, 2010; Johnson, 2003; Kelchtermans, 2006; Vescio et al., 2008).

Hargreaves' view that collaboration should be, "spontaneous, voluntary, development-oriented, pervasive across time and space, and unpredictable" (1994, p. 195) has real implications for teams of teachers in shared NGLE. Often such arrangements are predetermined in a way that Hargreaves would categorise as "contrived collaboration" – arrangements that are fixed in time, compulsory, predictable, and consequently frequently subject to micro-politics (Datnow, 2011; Hargreaves, 1994).

Negotiation and dialogue underpin the co-construction of meaning that allows people to journey beyond an individual and therefore more limited view of what is possible (Game & Metcalfe, 2009; Gray, 1989; Roth, Roth, & Zimmermann, 2002). Building on Vygotsky's social constructivist theory, Roschelle (1992) notes that this convergence is achieved through "cycles of displaying, confirming and repairing shared meanings" (p. 237) and forms the 'crux' of collaboration. These shared meanings are in turn subject to review and revision, emphasising that collaboration is as much a journey as a destination (Gajda, 2004). Understanding the nature of collaboration – the work teachers do together in NGLE, and the work they do apart, as well as the way that this is co-constructed, therefore becomes critical.

If new environments present opportunities for new models of in-situ professional learning communities for co-located teachers, the systems and structures that teacher teams develop together to support their collaborative practices are fundamental to successful student learning. Hansen (2009) asserts that, “bad collaboration is worse than no collaboration” (p. 1), and that instead “disciplined collaboration” should be employed – i.e. the practice of knowing when to collaborate (and when not to) – as well as having the disposition and motivation to do so. However, what does this look like in the context of modern learning environments?

### *Team Teaching*

Team teaching approaches are viewed as a preferred strategy accompanying new generation learning spaces (Alterator & Deed, 2013; Gislason, 2009), and are consequently experiencing somewhat of a renaissance. As a pedagogical approach, team teaching is nothing new. Although references to such approaches have seen limited exposure in schools since open-plan schools lost their appeal in the early 1980s, they have been seen as one strategy to address concerns over the gap between general and special education delivery models, and as an approach to mainstreaming students (Bauwens, Hourcade, & Friend, 1989). Consequently much of the contemporary literature is situated in the Special Education field.

In describing what team teaching looks like Friend, Reising and Cook (1993) suggest a number of possible arrangements within a classroom setting in which teachers share or divide the class:

- One teach/one observe – one teacher takes the lead while the other teacher gathers academic, behaviour or social data on students.
- Station teaching – the content to be delivered is divided, each teacher taking a responsibility, while students circulate from one station to the other.
- Parallel teaching – both teachers plan the instruction but divide the class into two halves
- Alternative teaching – the classroom is organised into one larger group working with one teacher while the other is teaching a smaller group
- Team teaching – teachers work together and take turns leading a discussion, presentation or demonstration
- One teach/ one assist – one teacher takes the lead while the other teacher moves around the room assisting.

Utilising the six approaches, teachers are potentially able to meet the needs of students with individualised education plans as well as meeting the needs of the other students (Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010). In making the connection with new generation learning spaces, it is timely to reflect that spatial references are somewhat in absentia in team-teaching literature. The assumption seems to be that these practices are occurring in the confines of a single classroom (Friend et al., 2010), with generally two teachers.

Spatially this provides a contrast to the nature of many NGLE, which have been intentionally designed with a variety of learning configurations in mind. Two models have been particularly instrumental in NGLE thinking in the New Zealand context. Fisher's (2005) taxonomy of learning settings links pedagogical activity to spatial settings. It recognises alternate modalities of teaching and learning activity and varying student group sizes that each offer a variety of affordances. Similarly Nair, Fielding and Lackney's (2009) pattern language conceptualises different settings for different activities. Characterised by the language of campfires, watering holes, and cave spaces, it recognises the role of the formal, social and reflective in configuring spaces. Arguably both of these models place the emphasis more firmly on the learner rather than the teacher. Depending on the setting, a teacher may or may not be present depending on the activity going on. In grouping multiple settings together into a 'learning hub' (Fisher, 2005), individuals and groups have access to a wide range of pedagogical settings. The extent to which existing models of team teaching find cohesion with the spatially "complex, flexible arrangements" (OECD, 2013) required in new generation learning spaces is a relevant consideration.

The gap between concepts of teacher collaboration, pedagogical practice and learning environments, stretching through the socio-spatial landscape, represents a significant gap in understandings of the nature of teacher's practice in new generation learning environments. With extensive investment in NGLE currently underway in New Zealand this is a timely topic (Creswell, 2013, p. 68). A better understanding of the relationship between teacher collaboration, pedagogy and space will help support teacher professional learning in schools adopting collaborative approaches in NGLE.

### *What is Needed?*

The study described in this chapter situates itself at the confluence of learning environments and collaborative teacher practice research. It aims to develop a framework to help consolidate ideas about how teams of teachers operate together within the context of shared NGLE. It is framed by concepts of cohabitation, collaboration and co-construction. It recognises the idea that space is socially constructed (Lefebvre, 1991), that teachers make meaning in situ, and that NGLE are the site of multiple complexities. As such each NGLE is an assemblage (Dovey, 2010) of people, materials, space, and the interconnections between each. Utilising a framework developed by Atkin (1996) it aims to extrapolate the effective practices employed by a team of teachers working together in-situ, and to identify the underpinning beliefs and principles that inform this practice. Hattie (2012) notes the importance of teacher belief and 'mindset' in impacting on student achievement.

The resulting case study and emerging framework will aim to help move on towards a better understanding of collaborative practice within new generation



learning environments (Blackmore et al., 2011; Saltmarsh et al., 2014), as well as to better understand requirements of relevant professional learning both within school and pre-service.

With this in mind the central question is:

What are the beliefs, principles and practice underpinning effective teacher collaboration in a New Generation Learning Environment and how do they impact on student experience?

The central question is supported by three subsidiary research questions:

- What are the systems and structures that underpin pedagogical collaboration and how do teams of teachers develop them?
- What is the student experience of teacher collaboration in a New Generation Learning Environment?
- To what extent is the physical setting of a New Generation Learning Environment a factor influencing teacher collaboration?

## METHODOLOGY

The study takes an ontological position embedded in constructivism. It subscribes to the belief that meaning is not fixed; instead it emerges out of people's interaction with the world (Sarantakos, 2013). In so doing it subscribes to the notion that constructivism is about "realities and relationships" (Sarantakos, 2013, p. 37). This finds an underlying congruence with the nature of collaboration as a process as well as product, with space being made and re-made, and practices being the subject of 'serial redesign'. It recognises the changing nature of collaboration – of interactions between teachers, students and space – as well as acknowledging that these interrelationships are fluid and subject to temporal shift. Additionally it draws on Taylor (2013) in considering the spatially relational implications for case study approaches.

Building an understanding of 'what works?' in collaborative NGLE lies at the heart of the approach. As yet, although a growing phenomenon, this model is present in a relatively small number of New Zealand primary schools (Martin & Williams, 2012). Determining which of these form pertinent 'success case' models (Brinkerhoff, 2003) constitutes a critical juncture in the early stages of the project. In deciding which to investigate, the design follows Stake's (Stake, 1995) case study maxim, "The first criterion should be to maximise what we can learn...which cases are likely to lead us to understandings, to assertions, perhaps even to modifying of generalisations?" (p. 4). The three phases of the study are designed therefore to form an iterative data gathering approach (Miles, Huberman, & Saldana, 2014), leading through a process of 'progressive focusing' (Parlett & Hamilton, 1976) towards new understandings.

Taking this lead, the initial phase of the research utilises the expertise of a group of key participants, recruited through professional networks and subsequent ‘snowball’ strategy (Bryman, 2012). Selected due to their current roles in NGLE leadership, pedagogy and professional learning, the aim is to conduct semi-structured interviews that assist to understand, (1) the background to NGLE in the specific New Zealand context, (2) characteristics of pedagogical practices in collaborative NGLEs seen as successful, and (3) recommendations of NGLE schools regarded as exemplar sites. This builds on the notion of reputational site selection (Goetz & LeCompte, 1984; LeCompte & Schensul, 2010), as well as the practice of identifying and examining practice in exemplar learning environments (Blackmore, Bateman, Cloonan, Dixon, Laughlin, O’Mara & Senior, 2010; OECD, 2013).

The second phase of the study will involve ‘snapshot’ studies in six of the recommended sites. Using observations, images, and interviews with principals, teachers and students, the intention is to surface themes and directions for further investigation. Images and plans of NGLE spaces will also be collected to assist investigation of collaborative practice and potential relationships with types of learning spaces (Dovey & Fisher, 2014). Based on analysed data those sites considered “most promising and useful” (Creswell, 2013, p. 100) will be selected for continued study.

The third phase of the study will look in-depth at three of the sites. The researcher will spend approximately three weeks with teaching teams, split over the course of several months. Data will be gathered through field journal observations, interviews and documentation. Repeated visits will enable an iterative approach to be followed (Creswell, 2013; Stake, 1995). Return visits for further observations and interviews will also support a reflective cycle. This will ensure that sufficient data has been gathered to provide a strong evidence base for the findings of the research (Flewitt, 2014).

The study builds on the growing recognition of the value of gaining student voice as a key element of learning environment research, following suggestions that children are rarely consulted, or that their views on the matter are not taken that seriously (Blackmore et al., 2011; Flutter, 2006; Halpin, 2007). Taking the view of children as local knowledge experts (Clark, 2010) therefore provides an opportunity for predictive evaluation, to understand student experiences of new pedagogical approaches, teacher interactions, new environments, and how each influences the other (Lippman, 2010a).

The data collected via interviews, focus groups, and observations will be analysed using thematic narrative analysis (Riessman, 2008). Riessman notes that narrative analysis shares some of the hallmarks of interpretive phenomenological analysis as well as grounded theory. Unlike grounded theory where concepts emerge directly from the data (Strauss & Corbin, 1990), narrative analysis allows for prior knowledge and concepts to guide the inquiry at the same time as searching for “novel theoretical insights” (Riessman, 2008, p. 74).

## CONCLUSIONS & IMPLICATIONS

The development of learning environments that, in reforming ideas of built pedagogy exhibit intentionality around collaborative teaching practice, may not only hold the potential to change students' lives but also those of teachers. However these are indicative of places at the intersection of multiple layers of complexity.

From a design perspective, understanding the complex spatial, social and material practices in action within a shared NGLE is fundamental. If team teaching and collaborative practices are seen as supporting contemporary pedagogical approaches, how then are these translated into design principles? The design of learning space can have a bearing on how collaboratively teachers are able to work together (Lee & Ward, 2013). So what are the qualities of built environments that will help to enact this?

From a school perspective, how teachers and students navigate and negotiate socio-spatial complexities in new environments in order to form pedagogical alignments, will determine 'what works', and ultimately how successful each of them can be considered. For now they could be viewed as places-in-becoming (Dovey, 2010). Over time they will be subject to ongoing change as spaces are made and remade (McGregor, 2004), effective collaborative processes reviewed and revised (Gajda, 2004), and as culture, organisation and teaching practices are 'serially redesigned' (Blackmore et al., 2011, p. 37).

In equipping teachers to occupy collaborative spaces successfully, there is a potential need to further develop conceptualisations of professional learning communities 'in-situ'. Caution is required so that it is not assumed that on occupying new collaborative spaces teachers will know what to do. Assumptions about the manner in which teachers approach teaching and learning, as well as their use of space, both individually and collectively, has the potential to lead to design incongruence. In creating spaces for the next 50 years or so therefore, how can the built environment reflect the flexibility and adaptability that will help support teachers transition from the isolated to the collective?

How too can professional learning frameworks help support teachers' understanding of the beliefs and principles underpinning effective pedagogy within collaborative learning spaces? This includes developing not only teachers' spatial and collaborative literacy, but also the understanding of pedagogical practices that help to maximise the opportunities engendered by the provision of new spaces.

## NOTE

<sup>1</sup> Modern Learning Environment (MLE) is the preferred terminology in New Zealand, although is in the process of shifting towards 'Innovative Learning Environments' and 'Innovative Learning Spaces'. For consistency within *Evaluating Learning Environments*, MLEs will now be referred to as new generation learning environments.

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## EMERGING METHODS



*St Francis Xavier College  
Photo courtesy of Hayball Architecture  
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BENJAMIN CLEVELAND

## 7. EMERGING METHODS FOR THE EVALUATION OF PHYSICAL LEARNING ENVIRONMENTS

### CONTEXT

The field of post-occupancy evaluation (POE) has provided direction on how evidence can be gathered about the performance of educational facilities for over 40 years (Cooper, 2001). However, such work has generally overlooked the evaluation of learning spaces for pedagogical effectiveness, i.e. the suitability of the physical environment in supporting desired teaching and learning practices, activities and behaviours.

This chapter calls for, and introduces, new methods of learning environment evaluation that attempt to make explicit the connections between pedagogy and space. It also outlines a suggested framework for the further development of such methods.

The research is currently being conducted at the University of Melbourne in connection with the *Evaluating 21st Century Learning Environments* (E21LE) ARC Linkage project. Findings so far have indicated that a return to the origins of post-occupancy evaluation in the field of environmental psychology is required to support the development of evaluation methods that take into account both the physical and social components of the environment. Feedback is needed on just how effective specific ‘units of the environment’ (Barker, 1968) are as pedagogical settings.

### BACKGROUND

What are commonly termed ‘new generation learning environments’ (NGLEs) – defined here as learning spaces that provide a greater degree of spatial variation, geographic freedom and access to resources for students and teachers than traditional classrooms – are becoming common-place in Australian schools. The proliferation of these ‘non-traditional’ learning spaces has become a phenomenon as new facilities are built and existing facilities are refurbished (Saltmarsh, Chapman, Campbell, & Drew, 2014). However, not all NGLEs are equal: a variety of spaces tend to be grouped under this umbrella. In the primary and secondary school sector, Dovey and Fisher (2014) identified at least five distinguishable building typologies that could be considered NGLEs. These range from classrooms that have been updated with contemporary furniture and digital technologies, to transformable spaces that can be opened-up or closed-down through the use of sliding panels, to large open

spaces that commonly feature interior elements that help situate diverse teaching and learning activities.

The variety of ‘new’ facility typologies being built in Australia, and internationally (OECD, 2013), has provided a rich testing ground for updating pedagogical practice, both in individual schools and across whole school systems. With such an opportunity comes the need to evaluate these learning environments to determine which are best supporting desired teaching and learning practices, activities and behaviours.

The conclusions of a journal article co-authored by this writer in 2014 provide the ‘launching point’ for this discussion. Based on a critical review of the literature on the ‘evaluation of physical learning environments’ Cleveland and Fisher (2014) formed the following conclusions:

1. Approaches to evaluations that attempt to assess the effectiveness of physical learning environments in supporting pedagogical activities are in their infancy and require further development.
2. More research is required to develop rigorous methodologies and methods that can be confidently employed to assess the effectiveness of physical learning environments in supporting desired teaching and learning practices, activities and behaviours.
3. Such research could profit from an interdisciplinary approach that involves people from a variety of backgrounds, including but not limited to education, human geography, environmental psychology and architecture.
4. The development of formative evaluation methodologies, which could support the evaluation of educational facilities throughout their lifecycle, appears to be warranted (pp. 24–25).

Building on these conclusions, this chapter provides a suggested framework for the requisite research suggested above. In doing so, it discusses some of the work currently being undertaken by members of the Learning Environments Applied Research Network (LEaRN) at the University of Melbourne through an ARC Linkage project titled, *Evaluating 21st Century Learning Environments* (E21LE). This research is based on the contention that if physical learning environments are to be considered as spaces that provide a range of affordances for teaching and learning, then improved methods are required to evaluate the effectiveness of ‘units of the environment’ (Barker, 1968) as pedagogical settings.

To support arguments for evaluation methodologies and methods that can take into account the influence of ‘units of the environment’ on the experiences of teachers and students (i.e. pedagogical practice – see later in this chapter), a brief literature review is provided. It covers a range of issues concerning the field of evaluation and the domains of environmental psychology and critical human geography. The literature reviewed (1) explores selected theories that have informed the field of evaluation and some pragmatic issues that evaluators should take into account when

setting-up, conducting and reporting on evaluations, and (2) identifies the relevance of the domains of environmental psychology and critical human geography to learning environment evaluation.

Subsequently, after briefly discussing the metrics by which the ‘performance’ of educational facilities have been measured in the past, this chapter suggests future directions for research and evaluation and introduces the chapters that follow in the ‘Emerging methods’ section of this book.

## LITERATURE REVIEW

### *Evaluation: Approaches to Assessing Value and Supporting Decision Making*

*Defining evaluation: an evolving concept and tradition.* Evaluation is understood in various ways. Højlund (2014, p. 28) suggested that “evaluation is commonly understood as a tool informing policy-makers and civil servants of what works and what does not”. However, evaluation has been defined in alternative ways by various experts, revealing the broad scope of the concept and some differing perspectives on what evaluation is and what ‘work’ it can do.

Scriven (1991) defined evaluation as the systematic determination of the quality or value of something; Cousins, Goh, Clark, et al. (2004) defined evaluation as a process of systematic inquiry leading to judgements about the merit, worth and significance of a program or organisation; Davison (2004, p. 85) defined evaluation as the “application of values to descriptive data so as to say something explicit about the quality or value of the evaluand in a particular context”; and Johnson, Greenesid, Toal, King, Lawrenz, and Volkov (2009, p. 378) defined evaluation as “any application of evaluation processes, products, or findings to produce an effect”.

The literature indicates that the general logic of evaluation is inherently realist and rational and associated with assumptions about rationality and causality (Højlund, 2014). Carman (2011, p. 351) commented that such logic tends to “place a high value on the rational, objective, and technical aspects of evaluation, with a considerable focus on using evaluation to make decisions” – a perspective firmly grounded in rational choice theory. However, Højlund (2014) suggested that the literature shows that evaluations rarely do change policies and that this constitutes a paradox, “since the very objective of evaluation is to improve policy” (p. 26). Commenting further, Højlund proposed that, “ideally, evaluation improves policy through the instrumental application of an evaluation’s results (conclusions and recommendations)” (p. 29), yet went on to suggest that “positivist assumptions behind evaluation have been weakened somewhat over the last decades, as positivism [has been] challenged by phenomenological and hermeneutic traditions as well as critical theory” (p. 29), thus highlighting a trend towards more relational, rather than rational, framings of evaluation.

*Evaluating: what, why and how.* Davison (2004) suggested that evaluations are generally conducted for two purposes: (1) to find areas for improvement; and/or (2) to generate an assessment of overall quality or value for reporting or decision-making purposes. Davison identified the following things as commonly evaluated:

- Projects, programs or organisations;
- Personnel or performance;
- Policies or strategies;
- Products or services;
- Processes or systems;
- Proposals, contract bids or job applications (Davison, 2004, p. 1).

In framing evaluations, Davison (2004) suggested that the purpose of an evaluation should be carefully considered. If evaluating for accountability, she suggested that it was best to have an independent evaluation, but if the goal was more focussed on organisational capacity building or learning, she concluded that it was important to include stakeholder participation (a more relational framing of evaluation).

Evaluation theories may describe and prescribe what evaluators do, or should do, when conducting evaluations (Coryn, Noakes, Westine, & Schröter, 2011). Coryn et al. suggested that evaluation theory helps to guide people's choices about "evaluation purposes, users, and uses, who participates in the evaluation process and to what extent, general activities or strategies, method choices, and roles and responsibilities of the evaluator" (p. 199). To improve the likelihood of a good fit between an evaluation and its environment, Chelimsky (2013) concluded that people involved in setting-up evaluations (i.e. evaluators) should also consider: (1) the kind of evaluation that may be feasible, based on what has been learned about the program context and especially its history; (2) the types of evaluation questions that will be possible to answer; and (3) the appropriate individual or combined methods (p. 94).

To this end, Carman (2011, p. 368) commented that it is important to understand "why an organization chooses to engage in evaluation and how it intends to use the information". She suggested that such information can "help evaluators to make important decisions relating to evaluation design, data collection, and measurement". Further-to-this, Chelimsky (2013) counselled that as evaluations are performed in the real world, they are open to "political pressures by policy makers, planners, administrators, special interest groups, subject-area practitioners, participants, and all those who may be affected by the results—or feared results—of the evaluation" (p. 92). She suggested that such influences should be recognized and accounted for in appropriate ways and recommended that for an evaluation to be viable, the design must: examine contextual factors; set up a plan for dealing with potential problems of credibility and use; and lay a foundation for predicting and tracking the key external factors likely to affect the evaluation from beginning to end (p. 94).

With regard to reporting on evaluations, Chelimsky (2013) identified that it is important to produce a report that is technically accurate, but also clearly written

and without jargon. She suggested that reporting should not simply take the form of written reports and that face-to-face briefings and presentations to those involved in the evaluation, and especially those in a position to affect use, should be conducted to enable the processes, products and findings of an evaluation to be appropriately shared.

Finally, Davison (2004) concluded that it is important to take the time to critically review the quality of an evaluation itself. She suggested that evaluations should be judged on the following criteria: (1) the validity of their conclusions, (2) their utility to relevant stakeholders, (3) the way in which they were conducted, (4) credibility, and (5) cost.

### *Environmental Psychology, Critical Human Geography and Education*

Weinstein (1981) proposed that physical environments can have an impact on learning by moderating social, psychological and instructional variables. Based on findings from environmental psychology studies into person-environment relations, she suggested that the physical spaces in schools can facilitate or inhibit learning through both ‘direct effects’, such as noise or crowding, and through ‘symbolic effects’, such as when poor conditions communicate to students a lack of respect for them on the part of the school they attend. For these reasons, Weinstein recommended that learning environments in schools should be considered as important as the curriculum and that the physical aspects of learning should be carefully planned by teachers in order to match with teaching objectives and the learning needs of students.

Weinstein’s perspective, derived from the traditions of environmental psychology (e.g. Barker & Gump, 1964; Barker, 1968, 1976), provides a foundation for the arguments put forward in the later parts of this chapter with respect to re-framing of methods used to evaluate physical learning environments (see ‘Renewed approaches to the evaluation of physical learning environments’). To appropriately situate these arguments in the literature, this section of the chapter provides some important background on the fields of both critical human geography and environmental psychology.

*Soja’s critical human geography.* Soja (1989) suggested that only recently (from the 1980s) has the interpretive significance of space been recognised within the realms of critical social theory and given rise to the discipline of ‘critical human geography’. It was his contention that the influence of space should be considered more rigorously when seeking understandings of the social world. He proposed that critical human geography opened up avenues for the interpretation of social histories and settings through a critical spatialization. Such an approach, he claimed, may complement the temporal or sequential time-based histories that have historically been central to critical social theory. Soja promoted his approach to understanding ‘space-time-being’ as follows:

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Just as space, time, and matter delineate and encompass the essential qualities of the physical world, spatiality, temporality, and the social being can be seen as the abstract dimensions which together comprise all facets of human existence. ... How this ontological nexus of space-time-being is conceptually specified and given particular meaning in the explanation of concrete events and occurrences is the generative source of all social theory, critical or otherwise. (1989, p. 25)

Relating these ideas about 'space, time, being' to schools, Fisher (2002) argued that:

Critical human geography is another of the disciplines ... [that is required] in order to make some theoretical sense of why schools, as political places and spaces, are seemingly unconscious of the power of space. (p. 167)

*Lived experience of space: the value of the user perspective.* Building on Soja's ideas, Lees (2001) recommended a critical ethnographic approach to drawing out meaning within the context of a critical geography of architecture. She suggested that in order to gain understandings of architecture from a critical geographic perspective we must go beyond trying to understand architecture from a representational viewpoint and investigate the ways spaces are socially produced.

Providing a backdrop for these ideas, Lefebvre (1991a) argued that the production of space is never innocent and championed the spatial perspectives of inhabitants, or users, of different spaces. It was his contention that inhabitants felt space more than thought about it and therefore they encountered a concrete or subjective view of space through their lived experience (Merrifield, 2000). Furthermore, he suggested that the lived experience of space went beyond the visual to become experienced through all the senses.

Lefebvre juxtaposed these ideas about the lived experience of space with the ways in which he suggested architects and planners often experience and encounter space. It was his contention that architects and planners often operate within, and experience space, in the abstract stage of the design phase. Believing that user experience of space should be more closely considered when trying to understand the significance of space, he commented that, "what we are concerned with here is not texts (blue prints) but texture" (Lefebvre, 1991/1997, p. 138). In supporting Lefebvre's ideas about how to approach an understanding of architectural design, Merrifield (2000) stressed the importance of thinking about whose space we mean.

*Behaviour settings theory.* Behaviour settings theory was established by Barker (1968, 1976), an ecological/environmental psychologist, and his colleagues (Barker & Gump, 1964; Gump, 1974, 1980; Schoggen, 1989) to explain the influences that 'units of the environment' (behaviour settings) have on human behaviour. Together, they demonstrated that recognisable units of the environment



have a powerful influence over the ways people behave. They found that behaviour settings often had a stronger influence on people's behaviour than a person's individual inclinations. Scott (2005) explained this further. He suggested that behaviour settings coerce people to conduct themselves in certain ways as they encountered particular settings.

Behaviour settings theory recognises physical and social components of each unit of the environment. The physical components, or milieu, are characterised by a specific set of time, place and object props, and the social components are characterised by a set of attached 'standing patterns of behaviour' (Barker, 1968). Thus, behaviour settings are composed of a variety of interior entities and events, including people, objects (e.g. chairs, walls, pens, paper, computers), behaviour (e.g. lecturing, listening, sitting), and other processes (e.g. air circulation, sound transfer) (Barker, 1976). These components of the environment form patterns that constitute the boundaries of a behaviour setting and distinguish one setting from another. Bechtel (1977, p. 33) described the boundary of a behaviour setting as, "the place where the behaviour stops". Gump (1980) further stratified the physical components of behaviour settings to isolate the physical milieu from the human components. He identified three major components of behaviour settings: milieu, human components and program.

Heft (2001) concluded that although behaviour settings exist independently of individuals, they "occur naturally as a function of the collective actions of a group of individuals" (p. 253). As a result, behaviour settings do not change as individuals enter or exit, as long as an adequate number of individuals remain. To this end, Barker (1976) suggested that "it is common observation that the same people and objects are transformed into different patterns as they pass from one variety of setting to another" (p. 19). Indeed, both the physical and social components of a behaviour setting must be present for the setting to exist (Scott, 2005). For example, a game of cricket may be recognised as a behaviour setting. For this behaviour setting to exist, a sporting field and the required equipment must be present along with the required behaviours of the players. Should any one of these components be absent then the behaviour setting would cease to function.

Bechtel (1977) and Schoggen (1989) suggested that behaviour settings are often bounded by architecture. Both contended that architectural space can play a significant role in establishing behaviour settings by determining the physical boundaries of behaviour settings. Further to this, Bechtel (1977, p. vii) suggested that behaviour settings theory could provide a platform from which to pursue social goals through architectural design.

Gump (1974) promoted behaviour settings theory as a useful theoretical lens through which to investigate the role of space in schools, suggesting that:

Education is an environmental enterprise. Some have thought that it could be advanced by reliance on learning theory or principles from child development,

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but these thoughts arose out of social science's inability to deal with environments. As an environmental enterprise, education requires knowledge about environmental "milieu-with-program" units and concepts. (p. 593)

Gump (1980) and others (e.g. Gislason, 2010) have since used behaviour settings theory to inform their thinking about education as an environmental enterprise.

### PAST PRACTICES IN LEARNING ENVIRONMENT EVALUATION

#### *Metrics by which the Performance of School Facilities have been Measured*

Prior research across the primary, secondary and tertiary education sectors has revealed a variety of metrics by which the performance of educational facilities can be measured. Over recent decades, these approaches to learning environment evaluation have largely focused on features of the physical environment itself. For example, Sanoff's (2001) School Building Rating Scale tool is organized around the assessment of the following variables:

- Physical features
- Outdoor areas
- Learning environments
- Social areas
- Media access
- Transition spaces and circulation routes
- Visual appearance
- Degree of safety and security
- Overall impression
- Personal information

In contrast, but still with a strong focus on features of the physical environment, the Design Quality Indicators for Schools (DQIfS) tool developed in the UK (CABE, 2005) provides another example of a school evaluation approach organized around physical variables. These include the following:

- Functionality
- Access
- Space
- Uses
- Build quality
- Performance
- Engineering services
- Construction
- Impact

- School in its community
- Within the school
- Form and materials
- Character and innovation

While these measurement variables may be important, both examples omit consideration of the social or human components of the ‘learning environment’.

### *Early Approaches to Building Evaluations*

The first systematic building evaluations were conducted during the 1960s by academic researchers with backgrounds in environmental psychology (Cooper, 2001). In keeping with the literature reviewed above, these groups were interested in the interaction of people and their environment and wished to “make building design more rigorous and systematic” (Cooper, 2001, p. 159). Some of the earliest evaluations were performed on university dormitories in the USA (Preiser & Nasar, 2008) and on a variety of non-domestic buildings in the UK (Cooper, 2001).

A cessation of such activity followed building evaluations of public works projects and government buildings in the UK, USA, Canada, New Zealand and Australia during the 1980s. This was due to a lack of funding and a perception that the lens of environmental psychology had failed to deliver. According to Preiser and Nasar (2008) – prominent figures in the field of POE and Building Performance Evaluation – there was a perceived disconnect between the process and conduct of evaluations and the use of evaluative findings. However, they noted that academic researchers have recently become interested in building evaluation and begun to develop new perspectives from which to consider such evaluations. They reported that:

The 21st century has seen a new paradigm replacing the hierarchical, command and control, top-down approach with a consumer-oriented democratic approach, one that is autonomous, self-organizing, ecological, to sustain adaptation and continuous improvement ... It calls for fairness, open, two-way communication, community building, cooperation, trust and honesty. For places experienced by the public (building exteriors, and interiors used by many people), the values of the public (the consumer) take priority. (Preiser & Nasar, 2008, pp. 88–89)

With respect to the higher education sector, the conclusions of the *Learning Landscapes in Higher Education* report (CERD, 2010) support this notion. This report concluded that evaluation should move from “a focus on ‘spaces’ to ‘places’ with an emphasis on the social and pedagogic rather than the financial and the material (p. 47).

RENEWED APPROACHES TO THE EVALUATION OF PHYSICAL  
LEARNING ENVIRONMENTS

*Evaluating the Effectiveness of Units of the Environment as Pedagogical  
Settings: Future Directions for Research and Evaluation*

Although building evaluation methods that were informed by theories of environmental psychology may have fallen from grace during the period from the late-1980s to the mid-2000s, it would appear that such frameworks are again in their ascendancy. Addressing the missing link between (1) the findings of evaluations that make connections between peoples' lived experiences of units of the environment (i.e. their responses to different behaviour settings) and (2) the use of such findings, appears to be the locus of potential improvement in the way school facilities can be evaluated and understood. Gaining people's confidence in evaluation methodologies and methods that make strong connections between 'pedagogy and space' would appear to be a key step forward.

Given Ornstein, Moreira, Ono, Franca, and Norgueira's (2009) conclusion that "user-informed assessments increase the likelihood that a given school building fulfils its intended educational purposes to the greatest degree possible" (p. 364), it would appear logical that if learning environments are to be assessed for the ways they can support desired teaching and learning practices, activities and behaviours, they must be assessed subjectively within the context of the educational model(s) they are intended to support. Approaching school learning environment evaluations in such a way would overcome some well identified gaps in the literature. For example, Pearshouse et al (2009, p. 4) identified "a need for the educational sector as a whole to reconsider how to evaluate physical learning spaces, so as to more clearly assess how they satisfy design intentions and teaching and learning needs", while Gislason (2010) posited that:

Few studies of any kind have linked school design with the human interactions that govern learning environments, and none drew substantive conclusions about how the use and configuration of instructional space frame teaching and learning. (p. 128)

Evaluative frameworks aligned with Gislason's (2010) model for school design research<sup>1</sup> would address connections between the physical and social components of units of the environment. Gislason's model highlighted:

- Ecology – building design, technology and other material elements;
- Organization – teaching, scheduling and curriculum;
- Student milieu – learning and motivation, social climate; and
- Staff culture – assumptions, values, and patterns of thought and behaviour.

Evaluating school learning environments through the lens of critical human geography and environmental psychology would not only provide important

information about the design of learning spaces but also critically about how such environments were inhabited and used by teachers and students (i.e. information about the ‘programs’, ‘processes’ and ‘systems’ operating within and in connection to learning spaces). Evaluative findings about the later could aid the development of what Saltmarsh et al. (2014) described as ‘spatially responsive pedagogies’, which they suggested are underpinned by “commitment to collective learning with, about and within a particular environment” (p. 12). Involving teachers in the processes and outcomes of learning environment evaluations could also assist school leaders to effect a range of pedagogically-oriented changes in their schools. As Hargreaves and Fullan (2012) suggested, leadership for transformative change in teaching involves a mixture of ‘push, pull, and nudge’ effects. Sponsorship and participation in learning environment evaluations that produce findings linking pedagogical activity with the affordances of units of the environment would not only provide important information about what is working (or not) with respect to the design of learning environments, but also with respect to the pedagogical inhabitation and use of such environments.

## CONCLUSION

Based on the ideas discussed above about the value of critical human geography and environmental psychology as lenses for the evaluation of units of the environment in schools, the E21LE project is aiming to provide a range of evaluative strategies and tools that can be utilized by schools and governing agencies to influence *decisions* about (1) what types of learning spaces should be built or refurbished and (2) how school communities can get the most out of the spaces they already have through professional capacity building (*improvement*). Via both strategies, the project hopes to inform the push, pull and nudge factors of pedagogical change.

The following four chapters in the ‘Emerging Methods’ section of the book explore a range of vital issues associated with the metrics, methodologies and methods of learning environment evaluation.

Graeme Oliver explores the connections between innovation in educational practice and innovation in learning environment design, and explores a variety of issues associated with how best to evaluate the relationships between these social and physical components of the learning environment.

Taking a more positivist and statistical approach to learning environment evaluation, Terry Byers introduces methodologies and methods aimed at evaluating the effect of learning environments on students’ motivation, engagement and assessed learning outcomes.

Leanne Rose-Munro highlights the importance of the acoustic performance of learning environments – especially for students with hearing difficulties – and suggests an approach to determining the relative levels of inclusion that learning environments may provide with respect to speaking and listening.

And finally, Ana Sala-Oviedo and Wesley Imms explore important issues associated with how to appropriately frame and conduct learning environment evaluations. Drawing on evaluation theories about what evaluators should do when conducting evaluations, this work aligns with Coryn et al.'s (2011) suggestion that evaluation theory helps to guide people's choices about the purposes of evaluation, users, and uses of evaluate processes and findings.

#### NOTE

- <sup>1</sup> After Owens and Valesky (2007) and by deduction after Barker and Gump (1964).

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## 8. DEVELOPING NEW LEARNING ENVIRONMENTS

*Co-Constructing Innovation in Education Practice*

### CONTEXT

This chapter proposes a model for the evaluation of the effectiveness of innovative learning environments in supporting the achievement of innovative educational practices. The purpose of such evaluation is to inform improved practice in the future. A review of the literature suggests that the current models of evaluation in this field tend to be situated in the separate domains of architecture or education. The model presented here proposes a framework that enables both architectural and education perspectives to be considered in a developmental process. This supports the practice of co-constructing innovation in education through the most effective implementation of innovative learning environments.

### INTRODUCTION

The last decade has witnessed a series of investigations into innovative learning spaces in Australia, largely funded through the Office of Learning and Teaching (OLT) or Australian Research Council (ARC). Lee and Tan highlighted that “evaluations of learning spaces have been limited in depth, rigour and theoretical grounding, and heavily reliant on informal or anecdotal evidence” (2008, p. 3). Within their research, Souter, Riddle, Sellers and Keppell (2011) expressed concern that “although there is abundant, significant and expanding literature on teaching, learning and knowledge generation beliefs and practices, and an equally extensive strong body of work exploring physical and technological environments and systems for learning and teaching, published research intersecting both is uncommon and not well understood” (2011, p. 5). Each of these studies came to a conclusion similar to Cleveland and Fisher (2013) who suggested that “approaches to evaluations that attempt to assess the effectiveness of physical learning environments in supporting pedagogical change are in their infancy and require further development” (p. 24).

This chapter proposes an operational model through which to map the complex connections and relationships between building design and education practice. This is intended to further the development of the field of learning environment evaluation by addressing the issue that Souter et al. described as “a polarised body of work, one hand holding the theoretical and pedagogical and the other handling

the technological and physical” (2011, p. 5). This model has been developed as a means by which to conduct research into effective ways to analyse the connections and relationships between innovation in building design and education practice in a more empirical, rigorous and pragmatic manner.

The development of the model was directed by the key question: What operational models might best support the co-construction of innovative education practices in innovative learning environments?

Embodied within this question are a number of concepts that need to be explored in their own right before being integrated to develop a framework for a holistic analysis:

- What trends typify innovation in learning environment design?
- Is innovation in learning environment design viewed in the same way by architects and educators?
- What is innovation in education practice?
- Is innovation in education practice viewed in the same way by architects and educators?
- How can we evaluate the impact innovative learning environments have on innovations in education?

#### INNOVATION IN LEARNING ENVIRONMENT DESIGN

A first step is to describe the “technological and physical”; that is, current understandings of innovation in learning environment design. A survey of the literature on contemporary learning environment design reveals a number of issues.

There has been a determined effort by architects over the last two decades to engage more deliberately with the principles of teaching and learning when designing new learning environments. However, while there is growing consistency around the rhetoric relating to innovative learning environment design, there remains great diversity of opinion and practice around how innovation in design should be implemented to support innovation in education practice.

The *Defining Spaces for Effective Learning* project of the Joint Information Systems Committee (JISC, 2006) brought a range of experts together to develop a consolidated analysis of building development issues. The final report highlighted that “educational building is an expensive long-term resource” and recommended the following principles for designing spaces for effective learning. Learning spaces should be:

- Flexible – to accommodate both current and evolving pedagogies
- Future-proofed – to allow space to be re-allocated and reconfigured
- Bold – to look beyond tried and tested technologies and pedagogies
- Creative – to energise and inspire learners and tutors
- Supportive – to develop the potential of all learners
- Enterprising – to make each space capable of supporting different purposes

The Programme on Educational Building (PEB) project of the OECD produced the *Compendium of Exemplary Educational Facilities* (2006) using the following criteria to determine exemplary practice:

- Flexibility – transformable learning spaces, student centredness, problem-based learning facilities
- Community needs – engagement with multiple stakeholders, catering for life-long learning, sharing facilities with families and others
- Safety and security – meeting design standards, financial accountability.

These two projects represent a body of work that emerged from an architectural background seeking to make more explicit the connection between education principles and the physical learning environment.

There are also voices that advocate propositions for innovative learning environment design with an orientation to more active connection with digital learning in the design process. EDUCAUSE is one organisation that is representative of this approach. EDUCAUSE declares its mission is to “advance ... education through the use of information technology” (Lomas & Oblinger, 2006, p. 2). The organisation’s research and position papers advocate for innovative learning environments to encompass the following features:

- Digital – acknowledging that “technology” is a way of life for modern students
- Mobile – enabling the interconnection of multiple devices
- Independent – acknowledging the self-reliance of today’s students
- Social – enabling students to work and collaborate in virtual social groups
- Participatory – recognising that students may participate with global connections.

Brown (2006) emphasised the need to consider virtual space as a part of the learning environment. Similar themes were articulated through the *Futurelab* project, ‘*What if...? Re-Imagining learning spaces*’. This report proposed that new schools should be more than more comfortable warehouses and that new design should “enable learning in a range of sites and in a range of different configurations of people and resources ... enable flexible use of a range of different approaches to learning ... and reflect an understanding of how people learn” (2006, p. 12).

The Partnership for 21st Century Skills organisation in its white paper, *21st Century Learning Environments* (Partnership for 21st Century Skills, 2012), pictured these learning environments as support systems that organize the condition in which humans learn best. “Learning environments are structures tools and communities that inspire students and educators to attain the knowledge and skills the 21st century demands of all of us” (2012, p. 3).

The report *Innovative Learning Environments (ILE)* from the Centre for Educational Research and Innovation (CERI) of OECD (2013) used a case study approach (125 examples from 20 countries) to develop a model of “learning environment” and to provide examples of innovation in learning environments. This model was composed of four elements: learners, educators, content and resources

(2013, p. 11). The ILE report described a learning environment as “an organic, holistic concept that embraces the learning taking place as well as the setting; an eco-system of learning that includes the activity and outcomes of learning” (p. 22). Forty different features of learning environment design were identified in the ILE report (see [Figure 1](#) below).

Flexible	Evolving pedagogies	Future-proofed	Re-allocated
Reconfigured	Bold	Creative	Supportive
Enterprising	Supporting different purposes	Student centred	Problem-based learning
Community needs	Multiple stakeholders	Life-long learning	Safety and security
Design standards	Financial accountability	Digital	Mobile
Interconnection	Virtual groups	Collaborate	Participatory
Global connections	Access to teachers	Breakout spaces	Cooperative learning
Access to ICT	Multimedia support	Quiet spaces	Multipurpose rooms
Student-teacher conferencing	Community in the school	Professional practice	Different approaches to learning
Educators	Resources	Learners	Content

*Figure 1. A summary of terms used from an architectural perspective to describe features of innovative learning environments*

#### INNOVATION IN EDUCATION PRACTICE

The *Innovative Learning Environments* report (OECD, 2013) opened with the statement, “Innovation is a key element of today’s societies and economies, and that includes how we learn” (p. 11). Blackmore, Bateman, O’Mara and Loughlin (2012) noted that the “notion of innovation is itself problematic in education” (p. 10). They highlighted that innovation occurred in schools in environments that had to simultaneously provide services and maintain the smooth running of everyday practices. With the need for schools to operate as systems that provided stability, predictability and continuity, it is difficult for them to make fundamental transformations of structural and operational mechanisms. Given this context, the CERI report presented a conservative definition of innovation in its project cases. They defined educational innovation as “an intentional departure from the traditional approach of the large body of general or vocational education in its own context – i.e. it is deliberately innovative” (p. 25).

Defining innovation in this manner as contextual and self-referenced is applicable to individual educational organisations or settings, but does not help build a structural model of educational innovation that is transferable. A concept with transferability is needed to build a model that can be applied repeatedly across a range of situations, i.e. can develop the research qualities of validity and rigour. The Innovation Unit in the United Kingdom is addressing this issue. Hannon, Patton and Temperley (2011) highlight the need to differentiate between an innovation agenda and an improvement agenda in making educational change. They advance the argument that merely focusing on improving the current model of schooling will never by itself generate innovation that leads to different educational provisions and educational outcomes. They argue that innovation requires deliberate engagement with changing at least one element of the current educational provision.

This paper focuses on the role that innovative learning environments can play as the lead element for engaging in a deliberate process of innovation in education practice. If the innovation is occurring in only one area (innovative learning environment on its own or innovation in education practices on their own) then there will only be moderate achievement in innovation outcomes. This relationship is represented in the figure below.

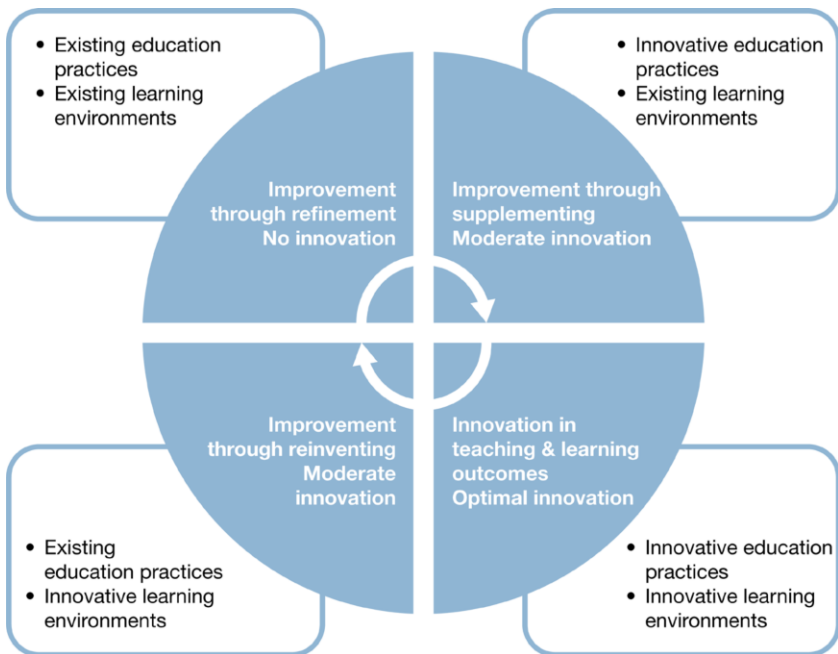


Figure 2. A framework for analysing the relationship between innovative learning environments, innovative educational practices and innovative outcomes in education (adapted from Hannon, Patton and Temperley, 2011)

While the framework suggests that innovation in learning outcomes occurs when there is engagement with innovation in both learning environment design and education practice, it does not mean to imply that innovation only occurs through a “leap of faith” into the bottom right quadrant. The nature of innovation is more nuanced than that. Steven Johnson in his book *Where Good Ideas Come From: the Natural History of Innovation* (2010) makes a case for rejecting the “eureka” moment portrayal of innovation and suggests that innovation is more likely to be “slow hunch” development through connections of ideas to generate new products or new practices. Building on this concept it is appropriate to consider innovation in education as an ongoing journey, rather than the achievement of a particular outcome. The arrows in the centre of the framework suggest this sort of dynamic. What the framework does is help map the journey of innovation. A school or learning institution could be working across all four quadrants of the framework at any point in time. At one particular moment the innovation could have a focus on the physical learning environment such as the establishment of a new outdoor learning area. At another time the innovation could have a focus on innovative pedagogies such as the implementation of problem based learning methodologies. Action on either of these innovations could be expected to lead to improved learning outcomes. The purposeful combination of action could provide the opportunity for truly innovative outcomes in teaching and learning in the manner defined by Hannon, Patton and Temperley (2011).

The relationships both within and between the quadrants are rich and complex. Cleveland (2013) identified 114 factors that influence innovation in schools, and through surveys with academics, educators and educational planners found that they reported a high proportion of these factors to be of high to very high importance

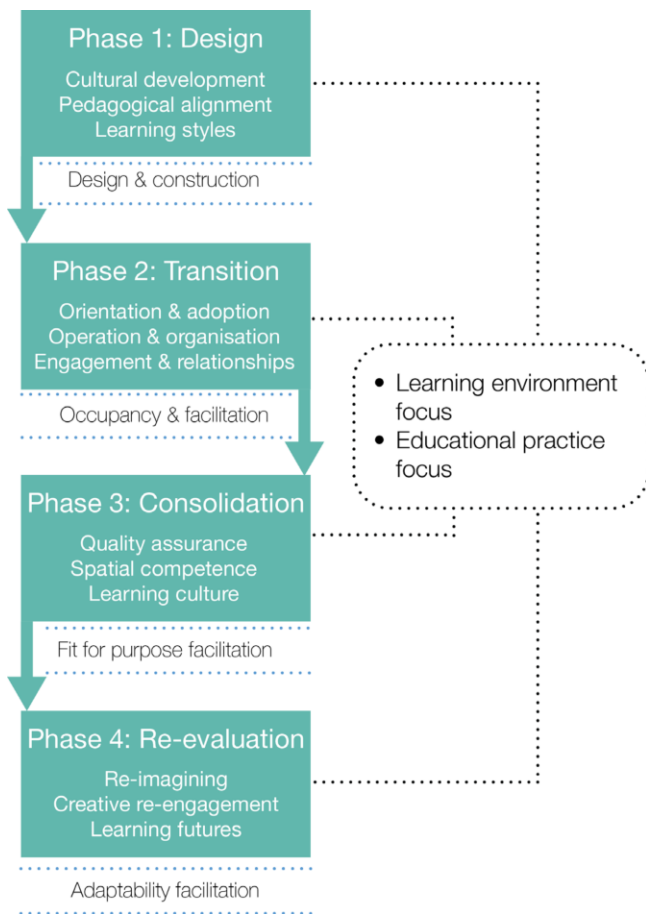
<i>Development Phase</i>	<i>Impact on Pedagogy</i>
Design	Consultation in design Clarifying educational / pedagogical principles Preparation for pedagogical change
Implementation & Transition	Orientation to space Rethinking pedagogical approaches Professional learning Utilising space
Consolidation	Changes in pedagogy Adaptive use of space Changing relationships and space Changing organisation and operation for space
Sustainability and Re-evaluation	Evaluation for innovation

*Figure 3. Framework for investigating innovative pedagogical practices and innovative learning environments (adapted from Blackmore et al., 2011)*

throughout the innovation process (p. 110) thus highlighting the extent of complexity to be addressed.

Oblinger (2006) stressed that “learning spaces mediate the relationships and social practices of teaching and learning, and are only one factor among many in the complex relationships of teaching that inform learning outcomes” (p. 5). Blackmore et al. (2011) provided a conceptual framework for their literature review to help organise this complexity developed from the perspective of impact on pedagogy.

This focus on the relationship between pedagogic practice and innovative learning spaces aims to set up an investigation that can focus on two key issues that are regularly identified in the literature on innovative learning spaces: the



*Figure 4. A model representing the co-construction of innovation in innovative learning environments and innovative education practices over time*



many factors and complex relationships that operate in the nexus between learning space and learning outcomes, and the limited research of a longitudinal nature in the field.

This writer has adapted the Blackmore et al. (2012) framework to include the perspective of architects as well as educators in the process of co-constructing innovation in the learning environment and education practice.

Figure 4 is significant in that it presents a timeline for considering the process of innovation, although no specific dates are suggested for the phases of the timeline at this stage. It also presents a framework for considering the participation of both educators and architects in the process of innovation. These are broad markers in a field that is characterised by high complexity.

Research in the field to date tends to be dominated by philosophical positions without direct connections to empirical evidence, there is little recognition of the context of schools (Blackmore et al., 2011), and there is little evidence that long-term changes in practice are occurring (Lee, 2011). This is made more complex by the fact that the field works across disciplines and professional areas (education and architecture), and that the body of work across these fields is not well connected and not well understood (Souter, 2011). The model presented above develops a framework to address of these issues in a systematic manner.

## CONCLUSION

This paper presents a proposal for investigating the question, ‘What operational models might best support the co-construction of innovative education practices in innovative learning environments?’ Literature reviews in recent years have identified significant gaps in the research that makes explicit connections between the implementation of innovative learning environments in schools and deliberate attempts to change pedagogic practices in these learning environments. This paper proposes using the temporal framework of Design/Transition/Consolidation/Re-evaluation as an organising tool and combines the perspectives of architects and educators in a process for monitoring and evaluating the impact that innovative learning environments have on innovations in education.

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## **9. A QUASI-EXPERIMENTAL AND SINGLE-SUBJECT RESEARCH APPROACH AS AN ALTERNATIVE TO TRADITIONAL POST-OCCUPANCY EVALUATION OF LEARNING ENVIRONMENTS**

### INTRODUCTION

The past decade has seen a resurgence in the literature concerning the effectiveness of physical learning environments. A worrying characteristic of this research has been a lack of rigorous experimental methodology (Brooks, 2011; Painter et al., 2013). This may be due to the difficulties associated with randomly assigning students and staff to specific settings and problems associated with accounting for the complex intervening variables that come to play within the educative experience (Byers, Imms & Hartnell-Young, 2014). Nevertheless Brooks (2011) lamented the disparity between the ‘potential’ of contemporary learning spaces and the seeming lack of empirical evidence concerning the impact of these spaces on teaching and learning.

This is especially true for secondary school settings. A prominent literature review by Blackmore, Bateman, O’Mara, and Loughlin (2011) indicated that there is little empirical evidence addressing the connections between physical learning spaces, teacher pedagogical practice and student learning experiences and outcomes. Blackmore et al. suggested that much of the research has focused on the design and physical attributes of buildings. Indeed, there is strong empirical evidence connecting the effects of the physical attributes of the built environment; for example air quality, temperature, and noise on student learning (Higgins, Hall, Wall, Woolner & McCaughey, 2005). Yet, like Uptis (2009), Higgins et al. (2005) argued that there is little known about how and why the physical attributes of a given space influence the teaching and learning process.

This chapter explores the development of a quasi-experimental and Single Subject Research Design (SSRD) approach to investigate the effectiveness of physical learning environments in primary and secondary school settings. This approach is put forward as an alternative to traditional methodologies used in the post-occupancy evaluation of learning environments.

## CONTEXT

In general, the few empirical studies that have been conducted around the effectiveness of learning spaces have bolstered claims about the positive effects of technologically enabled or active learning spaces on student learning outcomes. Much of this work has centred on two influential projects: North Carolina State University's Student-Centred Activities for Large Enrolment Undergraduate Programs (SCALE-UP) project, and Massachusetts Institute of Technology's Technology Enabled Active Learning (TEAL) project. Both incorporated a redesign of the course, curriculum and pedagogies, in addition to redesigning the learning spaces in which introductory physics courses were held (Dori & Belcher, 2005). These projects found that students in these 'studio physics' learning environments had lower failure rates and higher levels of conceptual understanding compared to students taking the same course in traditional lecture-based environments (Dori et al., 2003). However, Brooks (2011) is of the opinion that both studies suffered from methodological issues that have detracted from their effectiveness in linking attributes of the learning space with student learning.

The multiple changes to assessment, curriculum and pedagogical approaches, in addition to the changes made to the formal learning space in the SCALE-UP and TEAL projects is a source of methodological concern. Brooks (2011) was of the opinion that these multiple changes translated to a lack of sufficient control of confounding variables. For instance, Brooks (2011) identified that neither study accounted for a host of exogenous factors related to student body composition (i.e. student cognitive ability) and endogenous factors related to different instructors and therefore pedagogical approaches and changes in assessment methodologies between the 'experimental' and control groups. It has been argued that this lack of control obscured the relationships between changes to the learning environment and consequential effects on learning outcomes (Brooks, 2011).

It is suggested here that a more rigorous and systematic research design is required to empirically bolster the nascent link between contemporary learning spaces and effects on teaching and learning.

## RESEARCH DESIGN

The objective of this paper is to outline a viable and methodologically robust research design that can quantitatively examine and evaluate the causal links between changes in the physical learning environment and the subsequent effects on teaching and learning. This focus on causality would suggest that randomised experimental studies which represent the 'gold standard' of systematic evidence would be the ideal approach to adopt (Clegg, 2005). However, the nuances and ethical considerations of the schooling and tertiary education environments rarely support the requisite random assignment and absolute variable control of a randomised experimental

study (Shadish & Cook, 1999). An alternative, the subject of this paper, is a synthesis of quasi-experimental and SSRD research methodologies.

Even though quasi-experimental and SSRD are defined as different methodologies, they are similar in their aim, approach and means of analysis. Both are well-established approaches to non-randomised intervention studies in the applied and clinical health sciences and have been used extensively in particular rehabilitation studies (e.g. Harris et al., 2006; Johnston, Ottenbacher & Riechardt, 1995). Unlike randomised experimental studies, both approaches place greater emphasis on the design of the study rather than statistics alone to facilitate causal inference (Shadish & Cook, 1999). A key facet of the proposed combination is its ability to control the spuriousness effect/s of confounding variables and to then isolate and measure the effect of a single intervention (Coryn, Schröter & Hanssen, 2009; Robson, 2011). Controlling all other confounding variables improves both within-subject variability and internal validity (Rassafiani & Sahaf, 2010). These improvements are essential to enhance the rigour and reliability around the claimed causality between the intervention and desired outcomes (Harris et al., 2006; Mitchell & Jolley, 2012; West & Thoemmes, 2010).

#### METHODOLOGY AND METHODS

The collective work of Shadish, Cook, and Campbell (2002), Shadish and Cook (1999), Campbell and Stanley (1963) and Campbell (1957) is considered seminal in the fields of experimental and quasi-experimental design. An important theme of their work around the concept of causality is that ‘design rules, not statistics’ (Shadish & Cook, 1999). A thoughtful design is a proactive means of identifying and accounting for and the ‘plausible’ threats to internal validity and the spurious effect of confounding variables (West & Thoemmes, 2010). This ‘p priori’ focus seeks to moderate alternative interpretations or competing explanations for the observed effects (Coryn et al., 2009; Shadish & Cook, 1999). At the heart of this synthesised quasi-experimental and SSRD approach is a strong design focus that moderates plausible threats to the validity of the study.

##### *Quasi-Experimental Methods*

Campbell and Stanley (1963) identified a number of research designs that can be classified as quasi-experiments. Like true experiments, quasi-experiments test a hypothesis about the effects of interventions (treatments) that have been actively employed or manipulated to achieve an effect (Shadish & Luellen, 2012). However, unlike true experiments, the quasi-experimental design skirts the requirements of random assignment in treatment and non-treatment comparisons (Mitchell & Jolley, 2012; Robson, 2011). This lack of randomised assignment is the major weakness of quasi-experimental design (Harris et al., 2006). The result, according to Johnston, Ottenbacher, and Reichardt (1995) is reduced internal confidence of outcomes.

To moderate the impact of this weakness, the ‘logic’ of the quasi-experimental research design is paramount to ensure that the intervention preceded (temporal precedence) and caused (covariance) the achieved effect, with no plausible alternative explanation (Shadish & Luellen, 2012). Campbell and Stanley (1963) suggested that these ‘alternative plausible explanations’, or *threats to internal validity*, can cast doubt on the determination and justification of causal effect. The key threats of internal validity identified by Cook and Campbell (1979) are history, maturation, testing, instrumentation, statistical regression, selection, experiential morality and diffusion of treatment. West and Thoemmes (2010) suggested that the identified plausible threats should directly shape the research design, collection methods and analysis techniques. These design implications support the claim of successful integration of quasi-experimental and SSRD to develop a viable and methodologically sound quantitative research approach suited to learning environments research.

### *Single-Subject Research Design Methods*

A key facet of a SSRD is the selection of an individual, group or class of students, acting as their own control, baseline and unit of analysis (Cakiroglu, 2012; Horner, Swaminathan, & George, 2012). Comparing and contrasting each individual, group or class against themselves negates between-subject variability (Horner et al., 2005). It should be noted that in the applied health sciences the unit of analysis is traditionally an individual. However, this selection can be difficult to facilitate in school settings due to ethical issues surrounding the requisite anonymity of individual students. However, Kinugasa, Cerin, and Hooper (2004) are of the opinion that a group of individuals can become the unit of analysis if the sample size is large enough to meet the statistical power requirements to detect a statistically significant effect. For example, to achieve an adequate statistical power (greater than 0.8) to conduct a two-tailed hypothesis test with probability level ( $p = 0.05$ ) and estimated medium Cohen’s  $d$  effect size ( $d = 0.5$ ) requires a sample size of 128 (Faul, Erdfelder, Lang, & Buchner, 2007).

Underlying the quality and validity of a SSRD is the need to establish a stable baseline data set. Byiers, Reichle, and Symons (2012) described how the stable baseline phase was critical in establishing the benchmark against which the individual’s/group’s behaviour in subsequent conditions can be compared and contrasted against. An example of the importance and effect of baseline stability is evident in the Byers et al. (2014) study. The stable baseline data set was critical in attributing any statistically significant change in student perception of their learning experiences attributable to the intervention. The intervention in this study was the change in classroom layout from traditional to contemporary, with all other variables (i.e. teacher, class, subjects, etc.) kept constant. [Figure 1](#) provides a visual comparison of the difference between an unstable (class 7.2) and stable (all other classes) baseline data set. The degree of change throughout the baseline data set for class 7.2 indicates a high within-subject variability. This signified the presence

of unforeseen and extraneous confounding variables not accounted for in the initial research design (Byiers et al., 2012; Casey et al., 2012). This raised the problem of an inability to confidentially attribute the changes in student perception solely to the effect of the intervention (Creswell, 2005; Mitchell & Jolley, 2012; Shadish et al., 2002).

**Domain B - Effect of the Formal Learning Space on Teacher Pedagogy**

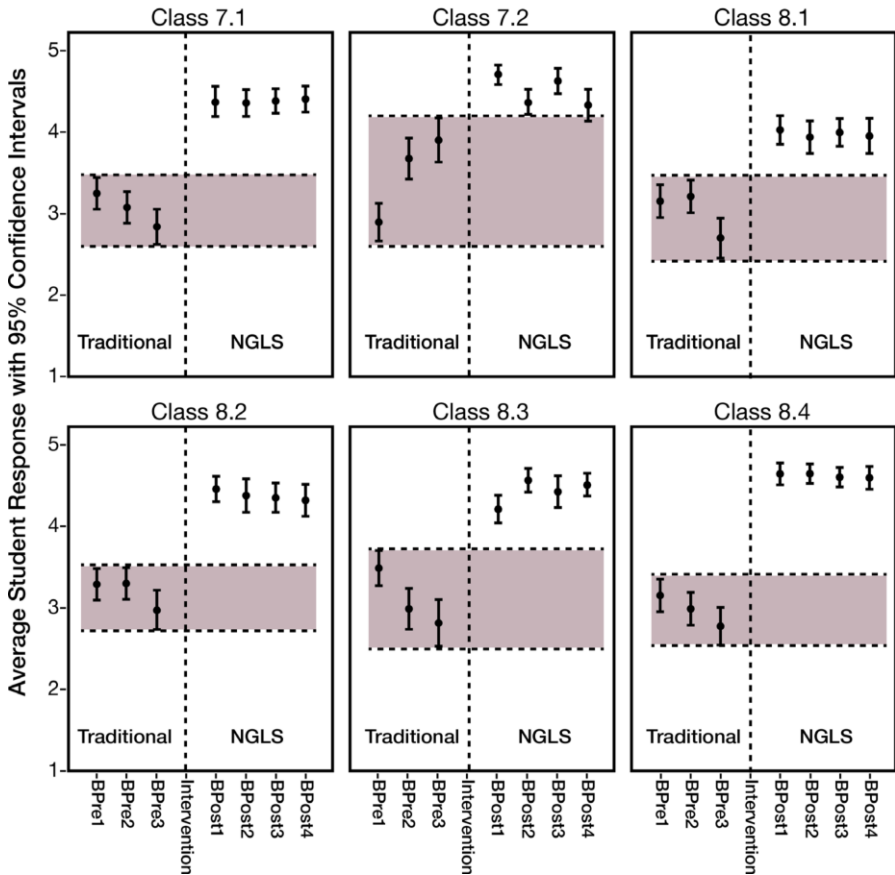


Figure 1. Byers et al. (2014) study and the effect of a stable baseline data set in the determination of statistically significant change

In this example, comparison of the class 7.2 data against the stable baseline data set for the other five classes made the range in which future data points fell more predictably (Byiers et al., 2012). This improved level of predictability indicated the lack of extraneous variables and therefore reduced within-subject variability. Therefore, the changes in student perceptions of their learning experiences can be



attributed to the intervention (Creswell, 2005; Mitchell & Jolley, 2012; Shadish et al., 2002).

### *Data Analysis Techniques*

The data from quasi-experimental studies is normally analysed through pre- and post-test comparison through inferential statistical analysis, while SSRD studies are evaluated through visual analysis (Beeson & Robey, 2006). The suggestion of a synthesised methodology extends to the synthesis of the methods of data analysis. By combining the strengths of visual analysis with quantitative effect size calculations, the strengths of one analysis approach is able to respond to the limitation of the other. The aim of this combined approach is to improve the statistical rigour behind the conclusions made.

Visual analysis is a proven mechanism for observing changes in level, trend and variability within and between the baseline and intervention periods (Byiers et al., 2012). Bobrovitz and Ottenbacher (1998) claimed that visual analysis has a proven ability to identify and derive a functional relationship between the independent and dependent variables. Generally, visual analysis has centred on the use of single point analysis. However, the addition of 95% confidence intervals to group means, can identify both inter- and intra-intervention trends (Nourbakhsh & Ottenbacher, 1994). Baguley (2009) was of the opinion that the addition of the confidence intervals is a superior approach to single point analysis as it indicates the plausible range of values that the 'true' effect might take.

Given the identified strengths associated with visual analysis, its limitations are also well documented. Beeson and Robey (2006) and Kromrey and Foster-Johnson (1996) outlined a common criticism directed towards visual analysis is its subjective nature. This subjectivity can lead to interpreter disagreement and resultant concerns around external validity (Bobrovitz & Ottenbacher, 1998). It has been suggested that an additional layer of quantitative statistical analysis is required to mitigate the subjective nature of visual analysis (Johnston et al., 1995; Kromrey & Foster-Johnson, 1996).

This paper is recommending the use of effect size calculations, as the additional layer of quantitative analysis. This recommendation is supported by the research of Beeson and Robey (2006) and Kromrey and Foster-Johnson (1996). Both utilised the use of effect size calculations to justify the outcomes of the visual analysis. The application of Cohen's  $d$  (mean shift) has the ability to mitigate the potential of Type I errors and reduce the sole reliance on interpreter judgement (Beeson & Robey, 2006; Kromrey & Foster-Johnson, 1996; Shadish, Hedges, & Pustejovsky, 2014).

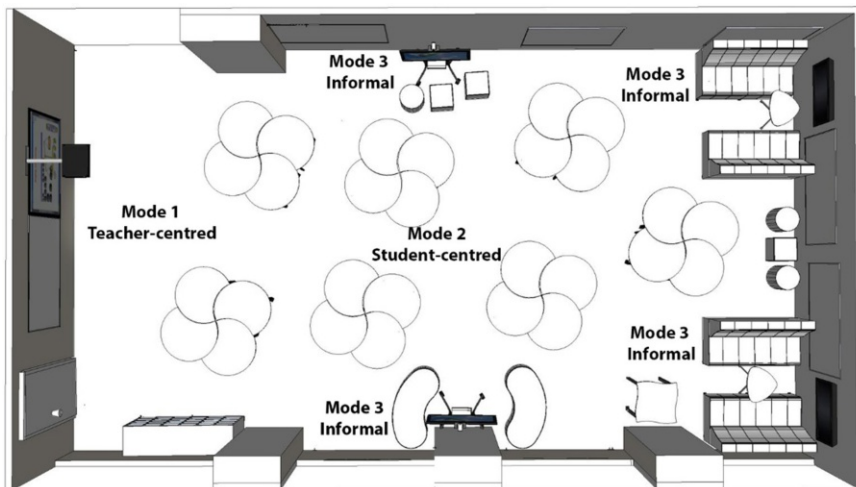
### *Findings and Results*

Byers et al. (2014) provided an example of synthesised SSRD and quasi-experimental design. Their study employed such an approach to examine the difference in

variables between two educational settings – ‘traditional’ classrooms, and ‘New Generation Learning Spaces’ (NGLS). The impetus behind this design was to address the paucity of systematic, empirical evidence, especially in Primary and Secondary school settings, connecting the impact of the learning space on teaching and learning (Blackmore et al., 2011; Brooks, 2011). It took its lead from the studies of Brooks (2011), Walker, Brooks, and Baepler (2011) and Whiteside, Brooks, and Walker (2010), all concerned with the University of Minnesota’s Active Learning Classrooms (ALC) project. These studies applied a quasi-experimental design to measure the effect of the change of the learning space (single variable intervention) on teaching and learning in a tertiary setting. These designs were able to moderate the effects of confounding variables such as the instructor, curriculum and assessment.

### *Study Design*

The aim of the Byers et al. (2014) study was to determine if changing the learning space had any effect on students’ learning experiences, and their levels of engagement. It utilised a SSRD in an attempt to control all factors (curriculum, student ability, class construction, assessment and the teacher) except for the ‘intervention’ (type of learning space). The intervention involved a retrofit of six classrooms, changed from a traditional classroom to the NGLS illustrated in [Figure 2](#) below.



*Figure 2. New Generation Learning Space (NGLS) layout (Byers et al., 2014)*

A baseline/intervention (A/B) design determined the effect of the intervention of the change in learning space (independent variable) on student learning experiences and their levels of engagement (dependent variables). Student attitudinal data was collected through a repeated measures survey. Each of the six participating classes

acted as their own baseline and unit of analysis. Student data was summed and treated as one subject across three baseline measures and four post-intervention measures. This number of measures was well within the parameters set by Vickers (2003) to ensure the desired statistical power (0.8).

### *Data Collection and Preparation*

The Linking Technology, Pedagogy and Space (LPTS) instrument focused on measuring the effect of the spatial intervention on the dependent variables of teacher pedagogy, learning activities, and student engagement. The survey Likert-scale items assigned to underlying scales represented each of the dependent variables. The LPTS questions relating to student learning experiences were derived from elements of the Tamim, Lowerison, Schmid, Bernard, and Abrami (2011) longitudinal study. The Tamim et al. (2011) study was chosen as it focused on active and more student-centred learning. The survey instrument was based on the APA Learner-Centred principles developed by Lambert and McCombs (1988). Questions relating to engagement were adapted from the *Motivated Strategies for Learning Questionnaire* (MSLQ) – a uni-dimensional student self-report questionnaire that focuses on motivational beliefs and self-regulated learning strategies domains (Fredricks et al., 2011; Pintrich & De Groot, 1990). The MSLQ has a proven track record in its use to evaluate instructional-based interventions (Fredricks et al., 2011; Pintrich & De Groot, 1990).

The study involved the participation of six Middle Years classes. The sample size ( $n = 164$ ) represented a significant proportion of (97.1%) of students from the participating classes. Across the baseline and intervention data collection phases a high retention rate (96.7%) was achieved and met the parameters set by Vickers (2003) to ensure the desired statistical power (0.8). However, Jenson, Clark, Kircher, and Kristjansson (2007) recommend that a complete data set will ensure the statistical power is maintained.

To maintain the sample size, a mechanism to deal with the ‘missingness’ was implemented. It was initially assumed that any missing data was classified as Missing Completely at Random (MCAR), due to random factors such as student illness or appointments at data collection times. This assumption was verified by Little’s MCAR test score greater than 0.05 (0.94) (Peugh & Enders, 2004). This result enabled a missingness approach to produce a complete data set.

A complete data set was produced in each instance through the implementation of the Maximum Likelihood Estimation (MLE) process and the use of expectation-maximization algorithm (EM). MLE is a robust technique for estimating missing data as it does not discard or try to ‘fix’ or ‘fill in’ the data (i.e. mean substitution) like more traditional methods (Little & Rubin, 2002; Peugh & Enders, 2004). The EM searches the available data for the parameters that will yield the best fit to the observed data, with the inclusion of the incomplete cases assisting towards a more accurate estimation. The work of Peugh and Enders (2004) suggested

that unlike mean substitution and linear regression, the MLE approach does not artificially truncate the variance and covariance around the mean. This truncation would unduly bias the visual analysis process by decreasing the spread of the 95% confidence intervals. This decrease in confidence intervals would increase the likelihood of increased instances of ‘false’ statistically significant differences or Type I errors.

The adequate sample size and high retention rate enabled post-hoc reliability analysis through Cronbach's Alpha. The aim was to determine the construct validity for each domain of the survey instrument. Cronbach's Alpha for the summative score for each class in each of the domains was calculated based on the suggestions of Gliem and Gliem (2003). The Cronbach's Alpha for the ‘Student Learning Experiences’ ( $\alpha = 0.88$ ) and ‘Student Engagement’s’ ( $\alpha = 0.86$ ) domains calculated coefficients indicated a very high level (when  $\alpha > 0.80$ ) of internal consistency across the multiple items. This signified an adequate level of reliability for the purposes of this study (Gliem & Gliem, 2003).

### *Data Analysis*

Statistical analysis of student attitudinal data was undertaken through visual analysis, justified by Cohen's *d* effect size calculations. A split-middle method of visual analysis derived a functional relationship between the independent and dependent variables (Nourbakhsh & Ottenbacher, 1994). Inter- and intra-intervention trends were identified through the projection of baseline data trends through the intervention phase, along with the application of 95% confidence intervals of class means (Nourbakhsh & Ottenbacher, 1994). Bobrovitz and Ottenbacher (1998) suggested that this is equitable to statistical analysis such as *t*-tests, but more suited to sample sizes such as found in this study.

In the Byers et al. (2014) study, the process outlined by Horner et al. (2012) was utilised to determine ‘significant’ and ‘non-significant’ statistical differences through non-overlapping confidence intervals between the baseline and intervention phases. This approach incorporated the criterion of level, trend and variability within and between the baseline and intervention periods. The approach concluded that in five out of the six classes (Figure 1) there was a clear statistical difference in student attitudes associated with the change from a traditional to NGLS classroom (see Table 1). All six classes indicated a clear statistical difference in student engagement in the NGLS compared to the traditional classroom.

To circumvent the criticism that surrounded the potential subjective nature of visual analysis, the Byers et al. (2014) study justified its conclusion through the application of effect size calculations. The thresholds suggested by Cohen (1998) were employed to elicit if the degree of the effect size correlated to a statistically significant effect. The Cohen's *d* (mean shift) that was computed in the Byers et al. (2014) study is summarised in Table 1 below. Statistically significant differences identified through the visual analysis process correlated to large (0.8 to 1.3) to very

large (greater than 1.3) effect sizes (Cohen, 1998). This is significant as effect sizes are considered the exact equivalent of *z*-scores (standard deviations above the mean) (Jenson et al., 2007). This would suggest that statistically significant differences identified through visual analysis were corroborated by an improvement of between 1 to 2 standard deviations when compared against the baseline data.

*Table 1. Summary table provided in Byers et al. (2014) study that compared visual analysis and effect size calculations for student learning experiences and engagement*

Class	Student learning experiences		Student engagement	
	Visual analysis	Cohen's <i>d</i> effect size	Visual analysis	Cohen's <i>d</i> effect size
7.1	Significant	1.50	Significant	1.63
7.2	Non-significant	1.04	Significant	1.38
8.1	Significant	1.01	Significant	1.34
8.2	Significant	1.31	Significant	1.73
8.3	Significant	1.35	Significant	1.16
8.4	Significant	2.01	Significant	2.48

The comparison between effect size calculations and the outcomes from the visual analysis resulted in some interesting findings. For example, class 7.2 achieved a slightly larger effect size in student learning experiences domain than class 8.1. Interestingly the visual analysis process identified only a statistically significant effect in class 8.1. This suggested that the ability for visual analysis to distinguish between results based on changes in level, trend and variability throughout the baseline and intervention phases signifies its statistical robustness.

### CONCLUSIONS

The aim of this synthesis of quasi-experimental and SSRD was to elicit initial empirical evidence around the effect of the formal learning space on school-age students. The Byers et al. (2014) study was able to moderate a number of confounding variables, such as the teachers, class composition and subject type. The analysis indicated that the method was able to correlate improvements in student attitudes around their learning experiences and engagement to the change from a traditional classroom to a NGLS. This study, while small in scale, provided findings that demonstrate causal linkages between contemporary schooling spaces and changes in teaching and learning. Furthermore, it validated the claim that a synthesised quasi-experiment and SSRD has the potential to be a statistically robust method for exploring this topic.

Quasi-experimental and SSRD research design do possess inherent limitations centred around threats to external validity through their predominant focus on

internal validity (Cakiroglu, 2012). The focus on a single unit of analysis conducted under a particular set of conditions in a particular context can lead to difficulties in generalization to other contexts or settings (Creswell, 2005; Shadish et al., 2002). In addition, context specific gender, ethnic and socio-economic characteristics also present generalizability problems. Another threat to external validity is the ability to generalise findings to past and future situations, depending on the timing of the treatments (Creswell, 2005; Mitchell & Jolley, 2012).

Even though the synthesised research design has proved to be successful, direct and systematic replication across a wider population is needed (Cakiroglu, 2012). The generalizability of the results of this model across different and multiple sites is required to validate its methodology in an educational context. The use of multiple and different class-types as the unit of analysis is needed to encompass the full range of student abilities and prevent selection bias. The replication of this approach can then facilitate both within- and between-subject comparison (Cakiroglu, 2012; Shadish et al., 2002). This degree and depth of data analysis would be expected to further reinforce the power and reliability of this synthesised approach.

#### IMPLICATIONS FOR TEACHERS AND DESIGNERS

In the context of research in an educational context, the synthesis of a quasi-experimental and SSRD methodologies can provide a simple yet effective method of identifying the effect of an intervention. The key to this approach is a well-thought-out research design. Where and when possible, within the nuances of the schooling context, the design must focus on a singular intervention or variable change. The focus on both the means of data collection and methods of analysis can attempt to moderate the spuriousness effect/s of confounding variables.

This approach has the potential to add dramatically to current learning environment research. It can make use of conceptual frameworks that are central to the assertion that the physical learning environment can act as a mechanism to hinder or support teacher pedagogical practices and therefore student learning experiences and outcomes. At this same time, this methodology can further generalise and validate the importance of the physical learning space. The empirical focus of this approach holds potential to illuminate the causal effects of contemporary learning environments on teaching and learning practices and outcomes.

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## **10. EVALUATING LEARNING ENVIRONMENTS FOR THE INCLUSION OF STUDENTS WITH HEARING DIFFICULTIES**

### CONTEXT

This chapter outlines an interdisciplinary approach to research and evaluation that accounts for technological innovations, pedagogical shifts and new legislative requirements for inclusion. Utilizing a mixed method multiple case study involving three students with hearing difficulties in one New Generation Learning Environment (NGLE), the research described in this chapter explores issues surrounding the inclusion of students with hearing difficulties in new generation learning environments.

At the time of writing, the study was in the final stages of data collection. This research explores the students' perceptions of inclusion, aiming to uncover instances of opportunity for equitable participation in speaking, listening and learning situations. Underpinning this research is Brinkerhoff's (2005) Success Case Methodology, and Radcliffe's (2009) Pedagogy/Space/Technology Learning Environment Evaluation Framework. Whilst data collection methods privilege student voice, other corroborating evidence such as quantitative acoustic measures to determine the building's capacity to control noise was collected. Photographs for the purpose of photo elicitation were gathered in an effort to enhance validity and support a multi-lens approach to understanding the setting. Interviews with school principals, teachers and students, with follow-up focus group discussions, broadened insights into the daily occurrences in the space.

The study contributes to the development of universally inclusive learning environments by providing new approaches to evaluating learning environments for the inclusion of students with hearing difficulties.

### INTRODUCTION

In mainstream school settings, a significant number of students have hearing difficulties. Recently it has become clear that even minimal hearing loss (16-25dB) can affect academic achievement (Spencer & Marschark, 2010). It is therefore important to evaluate how NGLEs help or hinder equitable access to learning opportunities and inclusion of students with hearing difficulties.

Drawing on Radcliffe's (2009) Learning Environment Design and Evaluation Framework and Brinkerhoff's (2005) Success Case Methodology, this research empirically maps the intersection between pedagogy, technology and space to determine if learning potentials of students with hearing difficulties can be facilitated in NGLs. Radcliffe's (2009) design and evaluation framework demonstrates the interplay between pedagogy, space and technology whilst providing an approach with which to address a host of issues associated with learning spaces. This research endeavours to add to the body of evidence that builds teacher capacity when it comes to manipulating the learning environment to maximise the learning potentials and inclusion of students with hearing loss.

In recent times, technology has changed the way educational spaces are configured and used. Increasingly, they are being designed to support speaking, listening and communication where collaboration, group work, complex problem solving, digital information gathering and publishing occur. These innovations and recent changes in legislation have highlighted the need for equitable access to learning environments for students with learning differences (disabilities). In designing NGLs there must be confidence that they are fit for purpose, account for diversity and ensure that speaking, listening and communication is accessible. These new spaces must support quality teaching and learning while also catering for the needs of all occupants.

NGL design intends to support pedagogies based upon the Vygotskian premise that learning is constructed in a social context. These spaces reflect a constructivist approach, one that argues that humans generate knowledge and meaning from interactions between their experiences and their ideas (Creswell & Plano Clark, 2011).

In mainstream school settings there is a diverse range of students with a variety of learning potentials and abilities. Based on his research of the developmental potentials in children, Vygotsky stressed the intactness rather than the deficits of the child. He commented:

A handicapped child represents a qualitatively different, unique type of development . . . . If a blind or deaf child achieves the same level of development as the normal child, then the child with a defect achieves this in another way, by another course, by another means; and, for the pedagogue, it is particularly important to know the uniqueness along the course he must lead the child. This uniqueness transforms the minus of the handicap into the plus of compensation. (Vygotsky as cited in Sacks, 1995)

The term 'mainstream' implies that children will need to adapt to fit in to the majority culture, and inclusion signifies that the program will make adaptation's to fit the needs of all students in the classroom (Stinson & Foster, 2000). In determining elements in NGLs that contribute to inclusion, it is important to consider the quality of the child's experiences whilst accounting for opportunities that help or hinder participation. A medical model of inclusion predetermines that many young people will lack achievement in education and assigns that lack of achievement to the

child's own deficit rather than the educational environment's failure to support them to learn (Abbott, 2007). In contrast, this research project sits within a transformative theoretical framework that aims to advance the needs of underrepresented or marginalized populations (Creswell & Plano Clark, 2011), and as such, endeavours to uncover the affordances of the learning environment that enhance inclusion.

Istance (2011) contends that learning in the 21st Century is not an entirely private matter associated first and foremost with the individual, but rather an accomplishment with and through others within a learning environment. This perspective is at odds with the traditional bureaucratic nature of educational institutions and formalized schooling structures that were based upon individualistic thinking. Istance further asserts that in seeking 'what works' in education, collective holistic solutions that take into account what happens at the macro, meso and micro levels are required. In evaluating inclusion in the learning environment it is acknowledged that policy (macro level) and governance (meso level), impact individuals differently within the learning environment at the micro level.

In formulating the methodology for this research, consideration was given to the kind of evidence deemed appropriate to support the inferences made about the level of opportunity and inclusion available to students with hearing difficulties in NGLs. Given the absence of evidenced-based research on inclusion of 'mainstreamed' students with hearing difficulties in NGLs, a multifaceted, multi-lens approach to data collection was taken to ensure reliability, validity and to mitigate researcher bias when evaluating student perceptions about the environment (Blackmore, Bateman, Loughlin, O'Mara, & Aranda, 2011; Spencer & Marschark, 2010).

Front of mind in considering the student's perceived level of inclusion is the quality of their experiences in the learning environment and their interpretation of such. Gibson describes an affordance as a quality of an object or an environment that allows an individual to perform an action (Gibson, 1977; Wright & Parchoma, 2011). Affordances are also properties of the system, as perceived by the user, that allow certain actions to be performed and which encourage specific types of behaviour (Cox, Webb, Abbott, Blakeley, Beauchamp & Rhodes, 2003). Affordances speak directly to the quality of an experience as a result of an action, and in doing so go beyond the current rhetoric of inclusive education policies that speak to the notion of reasonable adjustments ("Disability Discrimination Act 1992," 1992; "Disability Standards for Education 2005," 2005).

Research questions asked in this study included:

- What is the lived experience of students with hearing difficulties in new generation learning environments?
- How are teachers planning the use of the environment to promote inclusion?
- What level of noise is present in the environment?
- How and in what ways is communication facilitated?
- What elements within the open-plan learning environment facilitate opportunity for participation in speaking and listening?

- The primary aims of the project were twofold: to investigate the affordances of the environment that enhanced inclusion for students with auditory disorders and to investigate factors that enabled hearing accessibility in open-plan new generation learning environments.

The subsidiary aims were to:

- Investigate the environment's technology and acoustical affordances and properties to determine their influences on inclusion and subsequently what affordances should be adopted as best practice initiatives, and to
- Investigate the teachers' and students' preferential use of places to communicate within the learning space to determine how new generation learning environments could be best utilized for optimal access to speaking and listening activities.

#### BACKGROUND: 21ST CENTURY STUDENTS WITH HEARING DIFFICULTIES

Current research indicates that a significant number of students experience hearing difficulties. Australian Hearing, a statutory authority constituted under the Australian Hearing Services Act 1991, provided services to 68,296 eligible children and young Australians with hearing loss during 2012–2013 (Australian Hearing, 2013). An overwhelming majority of these students attended mainstream schools in their local communities (Byrnes, 2011; Vosganoff, Paatsch, & Toe, 2011).

Recently, Australian Hearing has introduced a new service that now diagnoses a hearing-related difficulty known as a Central Auditory Processing Disorder (CAPD), a subset of Auditory Processing Disorder (Bellis, 2002). Those diagnosed with CAPD find concentrating on speech and other cognitive tasks in the presence of background noise difficult, even though they do not have a hearing loss. In particular cases, students may have poor attention-switching abilities that are exasperated by noisy environments. CAPD impacts at least 10% of the indigenous population and 64% of adults over 55 years of age (The Hearing Cooperative Research Centre, 2014; Nelson & Soli, 2000; Wallach, 2011).

Collectively, 15% of the Australian population may have an Auditory Processing Disorder (APD) described as a listening in noise difficulty with or without the presence of a diagnosed hearing loss (Bellis, 2002; The Hearing Cooperative Research Centre, 2014; Sharma, Purdy, & Kelly, 2009). Additional studies have linked young children who commonly experience middle ear infections with hearing loss and APD (Flexer, Smaldino, & Crandell, 2005; Howard, Munro, & Plack, 2010). Research also indicates that younger students experience greater levels of hearing difficulties as the auditory network pathway responsible for decoding auditory verbal information is developing and continues to develop up to the age of 15 years (Smaldino & Flexer, 2012).

Further research indicates that students for whom English is an additional language, and those with speech and language difficulties, learning difficulties,

cognitive disorders, attention disorders and behavioural problems also have difficulties listening and interpreting speech in noise (Massie & Dillon, 2006; Rowe & Pollard, 2003; Sharma et al., 2009; Shield, Greenland, & Dockrell, 2010; Smaldino & Flexer, 2012; Snow & Powell, 2008). It is also widely reported that noisy environments adversely affect students with sensory disorders such as autism and vision loss by impacting cognition, heightening anxiety and diminishing access to clear speech (Anderson, 2001; Clark & Sorqvist, 2012; Guardino & Antia, 2012; Katte, Bergstroem, & Lachmann, 2013; Smaldino & Flexer, 2012).

#### POLICY AND GOVERNANCE AND THE IMPACTS UPON INDIVIDUALS

*Transparency and Accountability* and *Meeting Student Need* are key areas of reforms that can play a role in addressing the quality of hearing accessibility in the built learning environment (Hooge, Burns, & Wilkoszewski, 2012). The connection arises as educational institutions must account for the quality of services provided, in terms of quality of education (effectiveness), value for money (efficiency), equity and access (Australian Education Act, 2013). Building compliance and legislated regulations can be used highly effectively to meet student need, for example, provision of appropriate hearing access solutions and listening environments for hearing impaired students and students with additional sensory needs such as autism and vision loss (Guardino & Antia, 2012; Hooge et al., 2012; Hyde & Palmer, 2010). [Figure 1](#) gives an overview of current legislative initiatives underpinned by human rights movements that aim to enhance accessibility to quality experiences for people with differences (disability) in public meeting spaces in Australia. This encapsulates learning environments that are classified in the Building Code of Australia as a Class 9b building, public meeting space.

Innovations in acoustic design, building materials, and legislative changes that broaden the scope of hearing access continue to develop. However, research on a range of benchmark standards aimed at reducing noise and increasing hearing accessibility in open-plan learning environments is limited.

Emerging methodologies must reflect the researcher's awareness of their own, and competing paradigms, whilst adhering to the standards of their own methodological perspectives. The evidence must be reliable, valid and trustworthy; account for theoretical perspectives; aim to develop generalizations based on findings, and add to the understanding of issues in education (Bradley, Royal, Cunningham, Weber, & Eli, 2008).

#### EMERGING METHODOLOGICAL APPROACHES

Learning spaces are auditory verbal environments where the primary information exchange occurs through speaking and listening activities (Munro, 2011). This poses a substantial barrier to the estimated 7–10% of students in every class that have a hearing difficulty, particularly when it comes to accessing learning opportunities



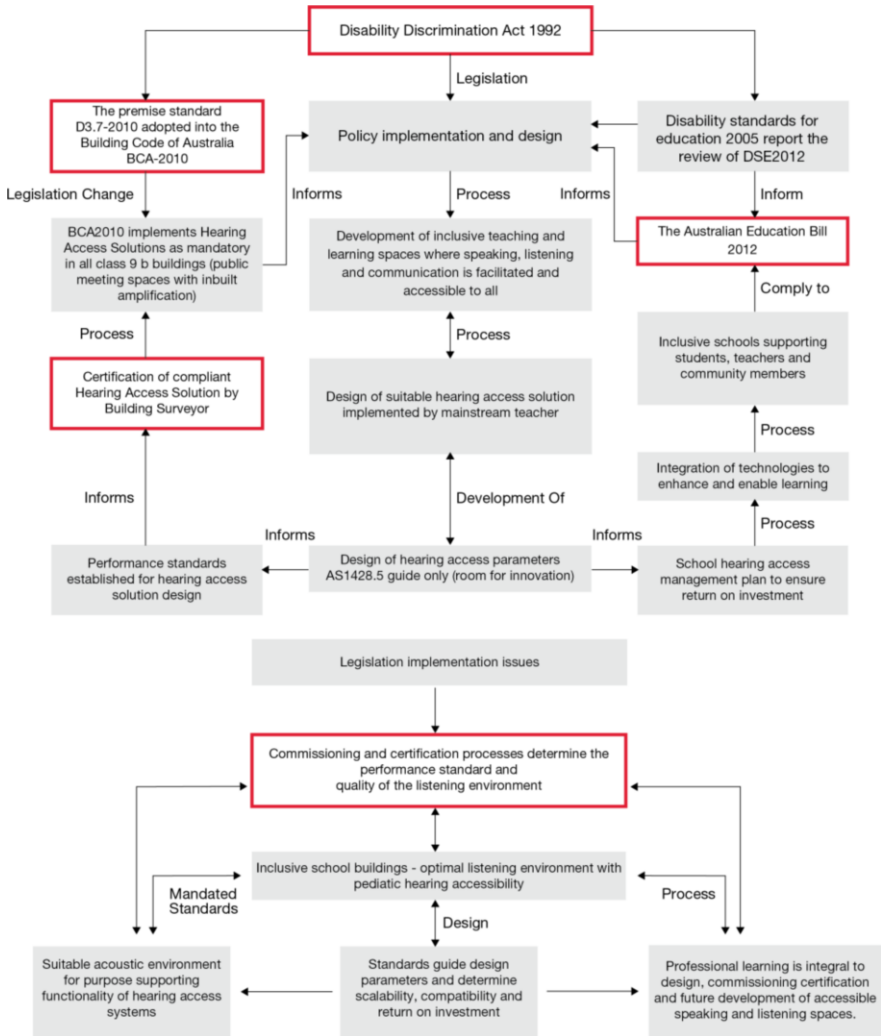


Figure 1. Overview of current Australian legislative initiatives underpinned by human rights movements

involving speaking and listening. Currently little is known about students with hearing difficulties in open-plan learning spaces and how they engage with auditory and visual cuing opportunities using a range integrated technologies in the context of differentiated and personalized learning.

Presently there are no known optimal acoustic design parameters and measures for open-plan NGLs (Shield, Greenland, & Dockrell, 2010, Robinson & Rose-Munro,

2014). Yet a broad body of ‘deaf education’ research in recent times highlights the urgent need to optimize learning environment acoustics, particularly in mainstream settings. This is in order to address the quality of, and accessibility to, communication experiences, social emotional inclusion and to enable equitable development of learning potentials. In addition, much of the previous ‘deaf education’ research accounts for traditional cellular classroom settings and pedagogies (Vosganoff, Paatsch, & Toe, 2011, Smaldino & Flexer, 2012, Nelson & Soli, 2000).

In evaluating the level of inclusion in NGLs as perceived by students with hearing difficulties, account must be given to fast-paced changes and innovations occurring in the environment and how these changes affect students with hearing impairment. Kay asserts it is unfair and unproductive to expect students to meet new and higher expectations in 21st century learning spaces if the supporting infrastructure is not there (as cited in Bellanca & Brandt, 2010). However, little is known about technological, pedagogical and acoustical affordances in NGLs and how these elements play a role in creating new experiences for students with hearing difficulties (Brown & Eisenhardt, 1997; Glaser & Strauss, 1967; Spencer & Marschark, 2010).

Brinkerhoff (2005) developed the Success Case Methodology, a method for evaluating the impacts of change and learning on institutions. This methodology was selected for this research project because it accounts for the performance management system and acknowledges the role that learning plays in it to achieve results. For example, in evaluating the effectiveness of learning environments, account is given to the teachers’ understandings of the built environment and how they engage with affordances of the space. In doing so, a teacher’s capacity to manipulate space is evaluated and considered alongside a student’s perception of inclusion. These grounded theory-building approaches are more likely to generate novel and accurate insights into rarely explored phenomenon under study rather than rely on past research, particularly in times of fast-paced change (Glaser & Strauss, 1967; Hart, 1990).

## METHODOLOGY AND METHODS

Figure 2 is a visual representation of the Pedagogy-Space-Technology Framework (Radcliffe, 2009) in conjunction with Success Case Methodology (Brinkerhoff, 2005). The methodological approach aims to explore issues of inclusion for students with hearing difficulties whilst accounting for the complexity of variables that may impact the performance standard of the learning environment. The student’s experience is situated at the centre of the learning environment evaluation process.

The study described in this chapter utilized a mixed method multiple case study design involving three students with hearing difficulties in one NGL in which the students form the cases and the school is the site.

The aim of the emergent methodological approach was to capture convergent and divergent thinking regarding the intersection of the elements of pedagogy, space and technology in NGLs, and the subsequent impact upon inclusion of students

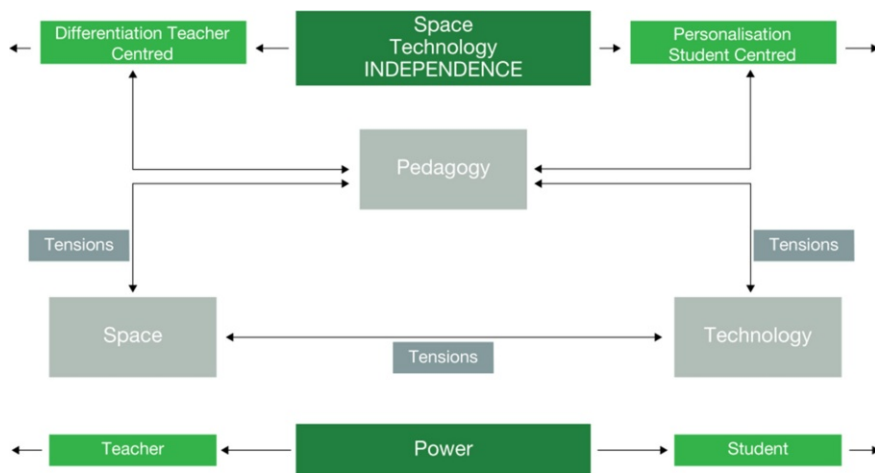


Figure 2. Pedagogy-space-technology framework & success case methodology: Exploring issues of inclusion in NGLE

with hearing difficulties. Radcliffe’s (2009) Pedagogy, Space, Technology Learning Environment Evaluation Framework was utilized as grounding for this research because it offered a simple framework that identified patterns in what institutions are trying to achieve, the ways in which they do this, and how they evaluate success. The questions asked within the framework can be tailored to meet particular ways of doing work, and the process is one which is “inherently self-documenting and aids the elicitation of lessons learned for future projects” (Radcliffe, 2009, p. 14).

Brinkerhoff’s (2005) Success Case Methodology explores ‘what works’ in times of fast-paced change whilst accounting for the ‘value-add’ of learning. The intended outcome of the approach is to identify affordances that enable inclusion of students with hearing difficulties in NGLEs.

The objectives of the selected methods were to:

- Visually capture every day occurrences within the learning environment
- Record the acoustical properties of the learning environment
- Record accessibility to technology within the learning environment
- Document teachers and students perceptions of inclusion within the learning environment.

Table 1 summarizes the qualitative data collection methodology and aims. The evaluation framework questions were explored through semi-structured interviews with the case study students, their respective teachers, and principals. All interviews were transcribed, coded and thematically analysed. The qualitative data collection sought to understand how the elements of pedagogy, space, and technology interrelate in the learning environment to facilitate communication.

*Table 1. Qualitative data collection methods aims and objectives*

<i>Data collection models</i>	<i>Formal &amp; informal observations</i>	<i>Photo elicitation</i>	<i>Semi-structured interviews</i>	<i>Focus groups</i>
Data collection aims and objectives: Record the convergence of the elements of pedagogy, space, technology in the NGLE and the subsequent impact upon inclusion of students with hearing loss.	Record pedagogical enactment through mapping actions. Record planning processes and placement of activities and people. Observe and record actions and reactions to events within the space. Monitor accessibility to, and use of technology. Monitor furniture placement.	Take photographs for the purpose of eliciting a response regarding placement within the space. Preference of positions. Understand intended outcomes of furniture arrangements. Clarify perceptions regarding accessibility to speaking and listening in particular spaces and places. Collect corroborating evidence of perception of inclusion. Capture visual documentation the lived experience in a moment in time.	Seek explanations regarding the planning process and placement of activities, furniture and people. Seek an understanding of how students access speaking, listening and communication. Seek an understanding of beliefs and perceptions regarding technology use. Spatial awareness and perception of inclusion.	Deepen and broaden understandings of teacher/ student interpretation of accessibility to visual and auditory cues. Clarify perception of accessibility to speaking, listening and communication. Clarify accessibility to technology. Clarify noise control strategies; learning strategies. Clarify perceptions of inclusion.

Photographs of the learning environment were taken at various phases of the data collection process. This iterative approach allowed for the capturing of occurrences as they emerged. This approach to photo elicitation also enabled the participants and researcher to interrogate their own understandings of the phenomena under investigation (Moss, 2008). For example, students were asked to identify their favourite positions in the learning environment and photographs of these spaces were later used to elicit responses from other students and teachers. Teachers were intermittently photographed explicitly teaching in various positions, and later, their

decision-making regarding positioning in the space was interrogated. Furthermore, photographs of furniture placement and positioning of visual and auditory technology tools were used to elicit responses from participants.

The images were compared with written notes, recorded interviews and acoustic data. A noise logger, an acoustical measurement tool, logged the average equivalent background noise measured in decibels over time within a set position in the NGLE. This measure gave an indication of the typical background noise levels that students and teachers commonly experienced within this space over time. In addition, reverberation times were measured at strategic locations throughout the built environment. This was utilized as a simple indication of how the building was performing in terms of absorbing sound reflections or noise echoes.

Quantitative data were gathered and analysed in an effort to uncover evidence that corroborated or clarified what helped or hindered communicative opportunities for students with hearing difficulties in NGLes.

Table 2 summarizes the aims and objectives of the quantitative data collection methods.

Table 2. Quantitative data collection aims and objectives

<i>Data collection methods</i>	<i>Aims</i>	<i>Objectives</i>
Building Acoustical Measurements	Quantitative data regarding noise levels in the built learning environment and the building’s capacity to control noise  Measure: Reverberation times Noise logger Speech perception test Noise pressure levels	Accessibility to speech intelligibility  Noise levels and impacts of cognition; opportunity to engage.
Architectural Documents & Drawings	Building specifications Building documentation Design brief	Policy and procedure guidelines regarding the built learning space’s capacity to support speaking and listening  Legislated building performance standards
Technology Audit	Identification of the presence and placement of visual and auditory assistive technologies	Accessibility to technology

The emergent methodological approach was iterative, allowing for adjustments in response to data collection and the potential for uncovering rich and in-depth

findings about complex phenomena that was not clearly understood (Glaser & Strauss, 1967; Stake, 1995).

## CONCLUSION

This multi-lens approach valued collaboration sits within the philosophical framework of 21st century learning environments. The ontological and epistemological stance of this research also sits within a transformative framework that is concerned with emancipatory education that wishes to further the cause of under-represented and marginalized groups (Biesta & Safstrom, 2011; Freire, 1970; Hart, 1990).

Sampling is purposeful in Success Case Methodology because the focus is on systems and leveraging resources into continuously improved performance, and outputs included the sharing of knowledge gained. Success Case Methodology, although perhaps not in its purest form, seemed particularly well suited to evaluating the complexities of the performance of NGLEs. This was because the users of the environment, i.e. the students and teachers, reported successes and difficulties at the micro level, creating feedback that strategically outlined evidence-based opportunities for adjustments at the meso (governance) and macro (policy) levels. In the formulation of this methodological approach, academic achievement outcomes were not considered as corroborating evidence of the students' perception of inclusion in the NGLE. This was because learning outcomes were not under investigation. The performance standards of the learning spaces that enabled opportunities for participation in learning experiences were the central focus of this learning environments evaluation research.

Broad approaches such as those described above are supported by Kalikoff who put the case for a mosaic approach that involved the implementation of a series of textured and complementary evaluation strategies that aimed to provide reliable and detailed information about what was being accomplished in the context of the environment under investigation (Kalikoff, 2001).

Today, more than ever, school management systems and infrastructure are increasingly required to improve the capacity of the performance drivers and professionally develop staff in an effort to keep up with successful innovative approaches. In the context of this study consideration was given to teacher professional learning regarding new pedagogical approaches, technology innovations and new learning spaces. Identifying how these interrelated elements perform in NGLEs, and the subsequent impacts upon inclusion of students with hearing difficulties was found to be essential.

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## 11. THE ROLE OF EVALUATION AS AN EDUCATIONAL SPACE PLANNING TOOL

### INTRODUCTION

When an educational facility is to be built or refurbished, ideally a team of educators, designers and governing educational bodies' representatives work together to ensure the facility reflects the educational institution's beliefs, the needs of the teaching staff, and the desired learning outcomes of its students. The ultimate aim should be to ensure the new facility supports the learners in the most effective way based on latest developments in educational theory, and research into 'what works' in spatial design. In reality, however, few educational space designs enjoy this level of scrutiny, most being designed and built with little input from educators. Under some circumstances an educational space planner (ESP) is employed as an intermediary between the designers, the builders, policy stakeholders, the school administration, the teaching teams, and the students. The role of the ESP is to ensure the design accommodates the school's educational vision and performs *pedagogically* as well as operationally. In this regard, the ESP occupies a highly advantageous position, owning equal insight into the design and educational aspirations of a build and being uniquely positioned to evaluate the degree to which the project is successful. Interestingly, little research has evaluated the impact of the ESP on the actual outcome of an educational project of this sort. This chapter explores the evaluative potential of the educational space planner.

### CONTEXT

It is when innovative approaches to learning are a goal, when spaces to support this innovation are explored, and when a strong alignment between the educational institution's teaching and learning and strategic plans and the physical space is envisioned, that an educational space planner is most relevant. In this context, the design process arguably becomes a highly collaborative event in which effective communication between experts in different fields is the key to the success of the design (Griffin, McGaw, & Care, 2012). It is also important to ensure that both the students and the wider community have a voice in this process and their needs and opinions are considered as far as possible (Woolner, McCarter, Wall, & Higgins, 2012).

The result that is sought is often an innovative solution or set of solutions, a step away from what other educational institutions are currently doing. While in

the tertiary sector there is usually a strong educational and strategic vision that new spaces have to support more often than not in schools, the opportunity for a new building or a major refurbishment is perceived and embraced as a catalyst for change, innovation and transformation at many levels.

Linking of pedagogy and space requires the matching of so-called 21st Century aspirations for teaching and learning to contemporary learning space design. This often implies a whole organisational change in which the alignment of new spaces, new curriculum, new delivery methods and new use of technology rely on an associated cultural change (Woolner et al., 2012). An ESP can assist in this process to ensure all components work together to create a successful and supportive environment that is welcomed by the learning community.

This requires extensive community involvement. Changes that aspire to be transformational and innovative should be managed through the early engagement of the whole learning community in the design process and the establishment of a common language that both educators and designers understand. The ESP has expertise in both architectural design of educational institutions and educational theory, and thus should be capable of facilitating meaningful dialogue between the parties. The role of the ESP remains relevant by ensuring that any recommendations are based on either academic research or, if this is not available, previously documented experience. What this means is that the provision of valid evidence is a continuous imperative for an ESP, and finding good evidence for recommendations is often a key task and challenge. The OECD's Innovative Learning Environments Project (OECD, 2013) acknowledges this when describing the 'nature of innovation':

Where there is scope for transforming structures, the processes to do this are complex with multiple stakeholders. Often those involved – parents, governments, and teachers – require convincing as to the need for, and nature of, the innovation. (p. 10)

The ESP must ensure innovative educational practices are accommodated within a new facility design, and that the design reflects the needs and aspirations of the whole school community.

#### THE ROLE OF THE EDUCATIONAL SPACE PLANNER

With increased use of ESPs, their critical intermediary role is becoming better understood, and can be summarised as containing eight aspirational goals.

*1. The ESP has knowledge of all specialist disciplines involved in the development.* The ESP must act as the prime interface between the design team<sup>1</sup> and the learning community<sup>2</sup> and should do so in a variety of ways. First, the ESP facilitates a common basic understanding of concepts and language between all. Second, the ESP defines the key educational, cultural and strategic aspirations of the school and possible translation into spatial solutions. Third, as the design evolves, the ESP enables the team to undertake collaborative problem solving exercises to overcome

the range of issues that arise throughout the design process, while remaining true to the agreed educational aspirations. In this way the learning community and the design team are able to co-create learning environments for new and emerging teaching, learning and research paradigms. The nature of the work of an ESP is fundamentally collaborative.

2. *The ESP adheres to a set of ‘principles’ that ensure successful implementation of a design.* The processes that build and maintain innovations, and the strategies required to transfer visions into new practices and ultimately spaces across the learning institution, need to be understood by all for effective implementation. The architectural design for an educational facility, either a new build or a refurbishment, is one of these processes. It responds to many parameters that are fixed but at the same time must also respond to a range of variables, in particular the educational model. How are the students going to be grouped? What kind of relationships should the space enable? These and other issues are reflected in OECD’s listing of the characteristics of innovative environments (OECD, 2013), summarised in [Table 1](#) below.

*Table 1. Adapted from OECD characteristics of innovative learning environments (OECD, 2013, p. 10)*

<i>Principle 1</i>	Learner Centred	The Learning Environment makes learning central, encourages engagement, and develops an understanding of their own activity as learners.
<i>Principle 2</i>	Social	The Learning Environment is where learning is social and often collaborative
<i>Principle 3</i>	Personalised and Inclusive	The Learning Environment is highly attuned to the learners’ motivations and the key role of emotions.
<i>Principle 4</i>	Personalised and Inclusive	The Learning Environment is acutely sensitive to the individual differences among the learners including their prior knowledge.
<i>Principle 5</i>	Personalised and Challenging	The Learning Environment is demanding for each learner but without excessive overload.
<i>Principle 6</i>	Structured and well designed	The Learning Environment uses assessments that are consistent with its aims, with strong emphasis on formative feedback.
<i>Principle 7</i>	Integrated	The Learning Environment promotes horizontal connectedness across activities and subjects, in- and out-of-school.

3. *The ESP is conversant with the latest educational theories that must be facilitated by the development.* School design is inescapably linked to the changing of workforce requirements. In this highly digitalised industrial age the skills needed by the main occupations rest on the capacity to develop, distribute and consume

products. The focus is moving to the production, distribution and consumption of information. This has implications for education, as individuals increasingly need to develop a new set of skills to respond to workforce requirements (Earthman, 2009; Myers, 2004).

In recent years organisations such as the OECD have explored what skills define the 21st century learner. Summarised as mixing traditional skills and new skills (Griffin et al., 2012), the Assessment and Teaching of 21st Century Skills Project (ACT21S, 2012) summarises these into the following four categories: (1) Ways of thinking, which includes creativity and innovation, critical thinking, problem-solving, learning to learn and the development of metacognition; (2) Ways of working, which includes communication, collaboration and teamwork; (3) Tools for working, which includes information and ICT literacy; and (4) Living in the world, which includes an emphasis on local and global citizenship, aspects of life and career development and personal and social responsibility.

The ESP must be conversant with not only the development of these rapidly changing aspirations but also be adept at how they translate into practices in the classroom.

*4. The ESP must be skilled at envisioning educational aspirations spatially.* Designing spaces to facilitate the pedagogies that modern epistemologies create is a challenge for the ESP; classrooms and schools must not only meet current teaching practice needs, but also the hard-to-define pedagogies required to address future learning. Planners and designers of modern day learning environments<sup>3</sup> are required to recognize that a complexity of needs creates the context of an ‘emergent learning environment’ and must design facilities to suit and present the learning community with a responsive and holistic design to address these needs. Listed below, these needs embrace the domains of what is to be learned, who is doing that learning, the role of the wider community, and the attributes of the design to address these needs.

### *Learning*

- The planning principles discussed above: learning as learner centred, social, personalized and inclusive, structured and well designed, and also integrated. (OECD, 2013);
- 21st century skills (Griffin et al., 2012);
- The articulation of a clear pedagogical vision and educational model – by or in collaboration with the school;
- The integration of educational technologies – the extent and aspirations for their use (Johnson, Adams Becker, Estrada, & Freeman, 2014);
- The changing role of the library and resource specialist (Streatfield & Markless, 1994);
- Linking culture, pedagogy, ICT and space.

### *Learners*

- Student cohort characteristics, such as those defined by SES, Indigenous needs and internationalisation of the classrooms;
- Teachers as learners;
- The type and intensity of relationships that are encouraged at all levels – for example, the student-student, student-teacher, student-community, student-executive, teacher-teacher;
- Spatial implications for special educational needs including and also extending the concept of inclusivity (Department for Education, 2005);
- How people learn (Bransford, 2000).

### *Learning Community*

- Sense of place;
- Involvement in the process of design and of evaluation (The-World-Bank-Group, 2014);
- Opportunities and constraints created by the role of the school in the community, and of the community in the school.

### *Learning Environment*

- The whole campus is a learning space;
- The (arguable) decline of the classroom;
- The use of the outdoors as learning spaces, creating a more holistic view of the learner and her/his association with the campus;
- Sustainability as a tool for design and for learning;
- Linking culture, pedagogy, ICT and space, in the process embracing a broader concept of educational technologies;
- Furniture and fittings.

This is a complex task to accomplish. While the needs outlined above are clear, as yet there is little rigorous evidence attesting to which physical learning environments are the more appropriate to support contemporary pedagogies in this digital and knowledge age. Not only are ‘new’ skills being demanded of the modern day graduate, pedagogies are in a state of flux, and ICT is evolving at a seeming expeditious rate. Unprecedented pressure is being placed on the educational system, and by association, on the designers of spaces where this activity is largely housed. The ESP must remain cognisant of these continual changes in the educational and learning landscape, and take leadership in effecting the required changes in established thinking.

*5. The ESP must utilize an evidence-based strategy for facility development.*

While 21st century learning remains conjecture to some degree, ESPs must accept the probability such an aspiration will become established ‘normal’ practice well within the life-span of the spaces they assist in designing. This ‘catering for future need’ is one measure of the success of a ESPs professional activity. Many educational institutions and governing bodies are keen to have evidence about the performance of new learning environments before they embark on expensive new builds or major refurbishment. This demands an evidence base that ESPs must assist in creating. While most in education are hoping for increased student engagement and performance from future designs, many are also looking at the potential impact of these environments on the development of 21st Century Skills such as collaboration, creativity and entrepreneurship. This need for evidence calls for the development of tools for measuring the performance of educational environments within the context of particular educational models.

*6. The ESP must successfully incorporate the well-established working processes of a range of disciplines into a successful project development.* There are different stages to the architectural design process, and each state, region or country has differing approaches. [Figure 1](#) illustrates but one. It describes a comprehensive process, with each stage of the design process supported by both architectural and educational planning activities:

Phase one encompasses the pre-design process where evaluation of existing facilities establishes an educational context for the new design. It addresses the question, “What is effective and what is important?”

Phase two relates to the concept and schematic design processes, and addresses the question, “How will the new space be used and how is it expected it will work?”

Phase three uses evaluation to determine the design’s response to the needs expressed in the previous stages. It can occur after the design is completed and during the construction phase. It reviews the previous phases to ascertain the learning community’s readiness to occupy the new spaces. It asks the question, “How do habitué intend to occupy this space?”

Phase four encompasses the build’s post occupancy evaluation, and addresses the question “Is the design, and resulting space, ‘successful’ and is it sufficient?”

*7. The ESP must be an evaluator.* Good ESP practice is iterative practice, each exercise informing the next, and each project adding to a knowledge base for future projects. Such iterative practice accommodates the complex variables represented in the educational sector, and the absence of any ‘grand narrative’ across all school designs. As in education where the ‘reflective and reflexive practitioner’ utilises evidence to improve teaching in a complex array of scenarios and over time, the ESP likewise utilises all evidence to develop and record a repertoire of knowledge that can be applied in particular circumstances. In this way, evaluation serves as a mechanism for ongoing improvement and for planning future change.

*8. The ESP has responsibilities beyond occupation.* A criticism of traditional architectural practice is that designs are often treated as complete once keys have



## Educational Planning Design Process and Evaluation

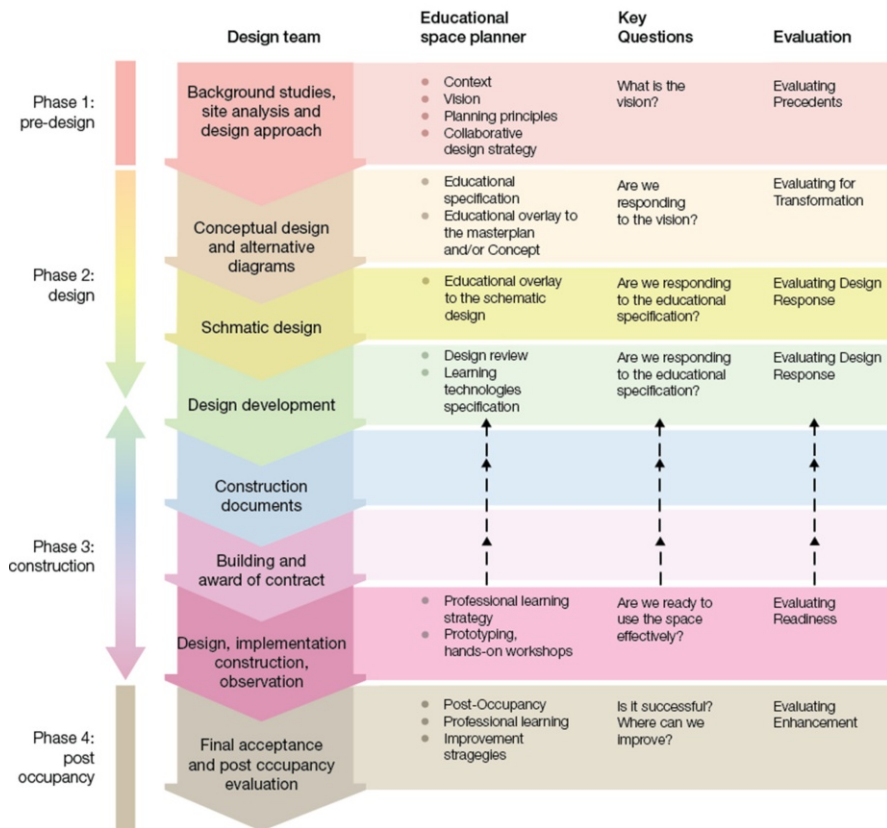


Figure 1. ESPs within the design process (adapted from Leung Planning and Design, 'Site Planning and Landscape Architectural Design'; [http://www.leungdesign.net/wp-content/uploads/2014/10/2014\\_LArch-Design-Process-diagram.pdf](http://www.leungdesign.net/wp-content/uploads/2014/10/2014_LArch-Design-Process-diagram.pdf))

been exchanged (Clarke & Dawson, 1999). However, people rarely occupy buildings as envisaged by the designer, and once in occupation they modify their surroundings to suit changing needs over time (Brand, 1994). The good ESP must provide services well beyond occupation, into that period described as 'inhabitation' where the habitué alter their practices to suit their surroundings, and conversely reconceptualise spaces to suit their particular physical and intellectual needs. Such services include ongoing evaluation of the space against baseline data collected during Phases One to Four, described previously.

### THE CRITICAL NEED FOR CONCEPTUALISING THE EDUCATIONAL SPACE PLANNER AS AN EVALUATOR

The previous section summarised the tasks that define good ESP practise and the principles ESPs should address to play a meaningful role in the planning and inhabitation of a new school building. The eight criteria indicate that the ESPs role is unique and, some would argue, critical to the long-term educational success of a new educational facility. Yet little attention has been given to evaluating the impact of these specialists, in particular their potential for ongoing development of new age educational design and use. Little attention has been given to the unique position the ESP owns in terms of utilizing their in-practice ongoing evaluations to inform superior design and use of new age learning environments. It is at this critical juncture that urgent research is required.

What should such research cover? It should fully document the role of the ESP and in the process determine in what ways she or he acts as an ongoing evaluator, enhancing the efficacy of learning environments designed to support 21st century pedagogies and skills. The research should document the ESPs role in identifying alignments and misalignments between desired pedagogical practice and educational objectives, the intended relationships facilitated, the affective influences and the user's behaviours as well as the learning outcomes, and the support the learning environment it provides to achieve all of these. The research should focus in particular on how the actions of an ESP informs not only the design of learning spaces from a pedagogical perspective, but also serve to establish baseline data for end-users as they occupy the building in the short term, then adjust and manipulate these spaces and practices within, over a long period. The latter action is termed 'inhabitation' (Imms, 2016).

Such research would investigate how the ESPs actions constitute an iterative, integral part of the design process. It would seek to understand if the ESP's actions could be viewed as 'applied developmental evaluation' – an evaluation for improvement before and during the design process, as well as after the building is occupied.

The research should examine how the ESP might be seen to act as an ongoing evaluator, utilising evidence to articulate core pedagogical, curriculum and organisational principles to be acknowledged by the design, and from this platform defining the programmatic, functional, spatial, and environmental requirements of the educational facility, whether existing, new or remodelled.

### THE ROLE OF EVALUATION IN ESP'S PRACTICE: A SUGGESTED RESEARCH APPROACH

As suggested above, a broad interpretation of evaluation underpins the actions of the ESP. It represents a much more complex view of 'evaluation' than is perhaps currently in use. In addressing this issue, the E21LE research team identifies

evaluation as traditionally being interpreted as the action of ‘determining the value or worth of a program’ (Cleveland, 2015). This understandable but somewhat restrictive interpretation does not necessarily service the broad range of *needs and purposes* being addressed by the ESP and required by teachers, designers and policy personnel intent on maximising the effectiveness of modern learning environments. In response, the proposed evaluation framework developed by Cleveland and Imms (2015) distributes existing and emerging evaluation strategies across a matrix that allows ‘users’ to develop bespoke evaluations according to their school’s particular requirements. This approach arguably overcomes to some degree the exclusive, specialist-only assumptions previously attached to assessing the value and impact of new and existing learning environments. To carry this point further, the argument of this chapter is that the ESP occupies a position to facilitate these types of ongoing, iterative and generative evaluations. It is this issue that requires immediate examination.

Such research should maximise work already done in this field, and then use emerging knowledge to direct research addressing gaps in ESP’s existing practice. It must formalise this approach within a theoretical framework that builds robust evidence, effectively scaffolding future developments. As an outcome it must provide a cohesive model of the interaction between ESP practice and ongoing evaluation. In brief, research is needed to consolidate what is known, theorise how this does and should contribute to scholarly knowledge of ESP practices, and establish protocols for future ESP practices.

What questions, then, should drive such research?

### *Issues*

The critical concept to be examined is how evaluation constitutes a vital element of educational space planning practices. This suggests a wide range of issues must be explored, for example:

- What are the evaluation tools at the ESPs disposal?
- To what extent and in which ways are these evaluation tools currently used to assist the educational space planning process?
- Which evaluation tools are ‘missing’?
- To what degree can an ESP use evaluation strategies to impart and impact change? How can ESPs use evaluation tools to enhance practice, align learning environments to educational imperatives, better use resources, and identify risk?
- How do ESPs know if the KPIs and questions in an evaluation tool are the right ones? That is, how do ESPs evaluate an evaluation?
- What are the circumstances that affect a learning environments evaluation tool’s effectiveness?
- How, when, by whom, on whom should evaluation be done?

- What is the role of the learning community, the financial and political overseers and stakeholders in this evaluation process, and how should ESPs most effectively enlist their support in an evaluation?

#### THEORIES THAT INFORM ESPS PRACTISE: AN EMERGING METHODOLOGY

The unique blend of architectural and educational theory that underpins such a line of enquiry is complex. Research into this phenomenon should follow the ontological position of constructivism. Constructivism asserts that social phenomena and their meanings are continually being produced by social interaction and are in a constant state of revision: they are socially constructed. It should also follow constructivist perspectives on learning and teaching. These are considered effective because of the holistic manner in which they are able to link theories of learning, motivation and development from the child's perspective, with emphasis on the active role of the learner in building personal meaning and in making sense of information (McInerney, 2010). According to Angela O'Donnell and colleagues (O'Donnell, Reeve, & Smith, 2009), constructivism describes how a learner constructs knowledge via different concepts: complex cognition, scaffolding, vicarious experiences, modelling, and observational learning. This makes students, teachers, the environment, and anyone or anything else in which the student has interaction, active participants in their learning. In the suggested research, these theories would acknowledge the reflexive and reflective nature of the modern teaching and learning space, and would provide a student/teacher centred framework for constructing measures of effectiveness and impact of the learning space.

An exploration of place theory would help in the understanding of what gives identity to or a 'sense' of space/place including a sense of belonging – a crucial factor in the evaluation of a learning environment (Dovey, 2010).

These positions on learning and place/space should be influenced by theories relating to the socio-material, in which relationships are enabled and fostered by space (Dovey, 2010), technology, texts, human bodies, intentions, concepts, nature and objects of all kinds, including 'objects of knowledge' (Fenwick, 2010). These theories argue the inhabitation of space goes from being separate to the physical body, to being a part of the user's day-to-day relationships (Mulcahy et al., 2015), helping reveal the dynamics of everyday life, which clearly includes learning.

Similarly, assemblage theory contemplates the concept of continuous change, but broadens its scope to include the inherent continuous change that comes from dealing with people as part of a system. It explores the idea of the complex relationships existing between social change and social networks and how these are seen as dynamic, adaptive, fluid and an ongoing process of emergence and becoming (Deleuze, Massumi, & Guattari, 2008). In complex systems theory, a series of dynamic, nonlinear interactions produce 'emergence' (Davis & Sumara, 2006), the understanding that in (complex adaptive) systems, phenomena, events and actors are mutually dependent, mutually constitutive, and actually emerge together in dynamic

structures. Actor-network theory looks at how entities, human and nonhuman, come together and connect, changing one another to form links that bring forth networks of coordinated action and things (Fenwick, 2010). These theories help ‘offer an alternative to the linear, reductionist approaches to inquiry that have dominated the sciences for hundreds of years and educational research for more than a century’ (Davis & Sumara, 2006).

Evaluation theory, in particular developmental evaluation, offers a framework that accommodates complex non-linear systems (such as a learning environment), and enables a continuous process of development, adaptation and experimentation using the results of the evaluation (Patton, 2005). Positive psychology focuses on the strengths, virtues, beneficial conditions and processes that contribute to well-being and positive functioning (Luthans, 2002; Norrish, 2013; Rusk & Waters, 2013; Seligman & Csikszentmihalyi, 2000). Appreciative inquiry involves the art and practice of asking questions that strengthen a system’s capacity to apprehend, anticipate, and heighten positive potential (Cooperrider, Stavros, & Whitney, 2008).

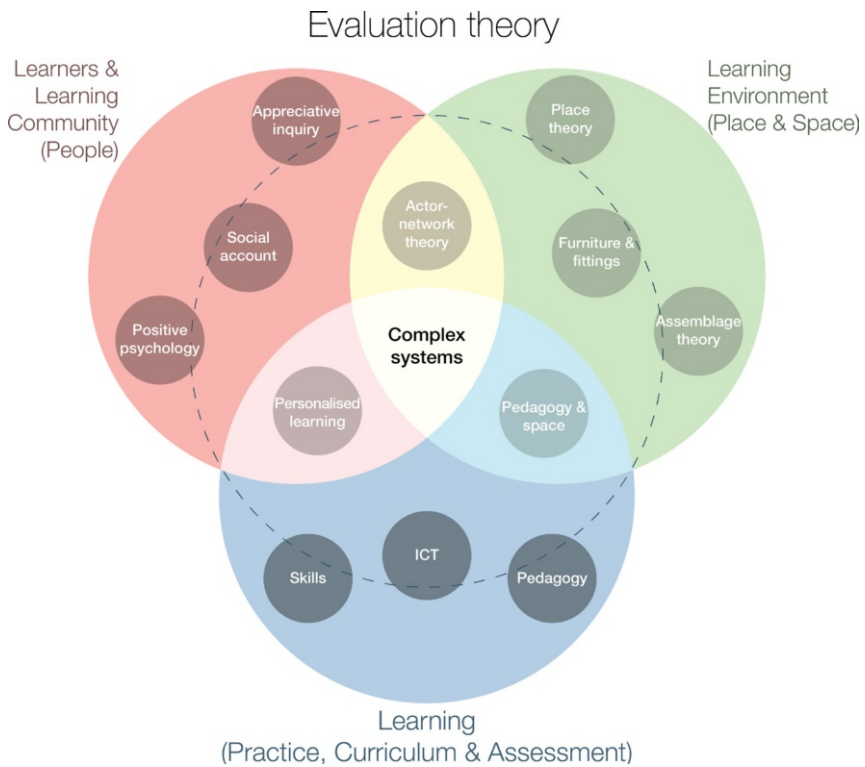


Figure 2. Summary and organisation of key theories pertinent to an examination of the role of evaluation in an ESPs practise

These three concepts help guide the development of questions and approaches used when interviewing ESPs and users of the spaces, in order to improve practice, relationships, and outcomes by focusing on what is already working well. Strategies derived from citizenship engagement and social accountability will support effective consultation. The former refers to users' active participation in the development of knowledge in a formative and collaborative manner, one that has a positive outcome for the learning community; and the latter, describes the extent and capability of citizens to hold the 'state' accountable and make it responsive to their needs (The-World-Bank-Group, 2014).

Figure 2 organises these complex theories into a cohesive methodological framework that includes 'people', 'place and space', and 'practice'. In the process key themes emerge, represented by the 'four Ls', that is Learners, the Learning Community, the Learning Environment, and actual Learning. These themes neatly summarise the eight core functions of the ESP's practise, described previously. Within this conceptual structure, a robust and informative examination of an ESPs practise can be organised. How should this research actually be structured and carried out?

#### IMPLEMENTING RESEARCH THAT EXAMINES ESPS PRACTISE: AN EMERGING METHOD

##### *A Suggested Design*

For the range of issues described previously, a mixed method research design should be utilised. Researching the use of evaluation to inform educational space planning practices across the 'four Ls', by default also examines the alignment of key affective domain practices such as the context of a build, the strategic and educational aspirations of the build, the actual performance of the build, and the relational and behavioural paradigms that impact the build and its eventual use. These orientations to the research can only be approached through a design that accommodates rich understandings of actual practices. Action research is one approach that will achieve this aim, where "the researcher and the members of a social setting (a school) collaborate in the diagnosis of a problem and in the development of a solution based on the diagnosis" (Bryman, 2012, p. 397). A case study approach is a second method. While case studies are a research design that entails the detailed and intensive analysis of a single case, it can be extended to include multiple sites for comparative purposes (Bryman, 2012). A combined action research and case study approach should allow a flexible inter-disciplinary approach to the research, depending as it does on philosophies, methods and knowledge particular to the disciplines of education and architecture.

A three-phase study is required to allow a logical development of knowledge from what is already known through to creation of new understandings about this aspect of ESP's practise. The first phase should establish an evidence base of existing evaluation practices of ESPs. The second phase should comprise field work that (1)

extends and refines these existing evaluation practices; (2) develops new evaluation practices to fill gaps in the conceptual framework illustrated in [Figure 2](#); and (3) from this work creates a framework of tools for different contexts and objectives. The third phase should evaluate the efficacy of this framework by pilot studies in a variety of schools. This final phase should utilise the approach illustrated in [Figure 2](#) to structure analysis and to guide documentation of findings.

Using the structure illustrated in [Figure 2](#) as a theoretical guide, the results of this research should be documented in a mix of written and graphic forms, in an iterative manner, to allow for review and clarification with participants in the research. This should ensure that the specific requirements of each community are accommodated, and should suggest possible next steps to better align ESP practice and organisation with the spaces and the intended outcomes, including giving specific professional learning initiatives.

Some caveats to this suggested design exist. Exploring how ESPs utilise evaluation as a tool is a challenge, and its success mitigated by how well it attends to the following issues:

#### *What Constitutes Evidence?*

Evidence-based design for learning spaces, while not necessarily a new thing, is not that well established in terms of quantitative research or in particular in its evaluative component. While there is plenty of research that supports (for example) a shift towards collaborative and personalised approaches to learning, the research around the spaces that support this is far from extensive, often contradictory and highly contextual. A literature and research review will seek to establish some clear and commonly accepted principles in relation to the evaluation of the effectiveness of learning spaces, but the remainder of this project will be guided by action research, case studies, consultation with identified stakeholders and educated assumptions around how the learning communities' aspirations are best supported.

#### *What is the Context for Evaluation?*

The same way that architecture should refer to the context where it sits (or otherwise make a point of not doing so, but cannot remain indifferent), it is most probable that the same set of tools for evaluation will not be able to be used for all learning communities (The-World-Bank-Group, 2014). Different evaluation tools will be needed for different learning communities, at different stages of design and for different respondents.

#### *How to Maintain the Research as an Inclusive Process?*

It is hard for many school communities to understand the relevance of a 'different' space. Change is seen as a threat and as a source of additional work, and it is so.



This is why it is crucial to be able to communicate effectively why the space is being considered or why it has already been done, and how it can benefit them to be able to support their practice and make the most effective use of the resources, both physical and human.

#### *How to Remain Genuinely Consultative?*

To a certain extent it is envisioned that the evaluative process will become an integral part of the inclusion of the learning community within the design process. Community participation is a key element in the success of the establishment of any change or innovation (Gaventa & Barrett, 2012). It will be necessary to identify key stakeholders for consultation throughout the life of the project in order to ascertain how well the tools are working to support this idea. The inclusion of appreciative enquiry as a leading theory behind the evaluation tools, as well as the use of rigorous questionnaire and interview design principles will help ensure that consultation remains relevant and that results can be used for formative and comparative purposes.

#### *How to Adhere to a Formative Process?*

It is important to ensure that the results are not only useful for the research but also relevant to each school in that they can learn from the process and identify opportunities for change. A positive/appreciative inquiry approach to evaluation in which once we understand the context, we can build on the positives instead of just 'fixing' what is not working, seems to be the most relevant evaluation for this context, as it also supports change management practices.

#### *What is the most Effective Mechanism for Disseminating Results?*

It is likely that the final format of delivery will involve online, digital and printed elements. This will require discussion around points of access by the learning communities. The distribution of material will also require a degree of strategic planning in regard to equitable distribution and ensuring the material is accurately interpreted. Solutions to the latter include access to online instructional videos, the use of consultation to discuss ease of use, and perhaps the offer of professional learning opportunities.

#### *How can the Research Remain Relevant to the Practitioner?*

One of the risks associated with evaluation of learning environments is that the inexperienced user may not have the skills, knowledge or confidence to interpret the questions they are being asked or the application within their unique learning and/or design context. The inclusion of relevant information will be critical in

getting users to engage with the evaluation and ensure the outcomes are relevant for the study.

*How can the Research Maintain Coherence?*

It is envisioned that a range of tools will be required to accommodate different contexts. While the final number of tools is undetermined, it is likely that there will be quite a few. Legibility of the final series will be critical. Clear connections between the evaluation and its purpose, simple and aesthetically pleasing graphic design, user-friendly access and clear guides for application will be critical

*How can the Research Protect the Temporal Aspects of its Findings?*

Learners and learning in the 21st century are continually affected by change. Rapid developments in technology will continue to affect teaching and learning and the settings used to support it. It will be important to consider how project outputs will remain responsive to change and implement a plan for cyclical evaluation, review and revision.

CONCLUSION

Within educational institutions, and in particular within schools, there is a general lack of understanding regarding the links between pedagogical practice and space, and the learning and teaching opportunities that this relationship presents. While many educational institutions and educators know that these are important, most do not really know in which manner or how to assess this impact, and use the opportunities presented by these links to maximize learning outcomes, promote positive behaviours and relationships, and improve well-being.

As yet there is little rigorous evidence attesting to the efficacy of which learning environments are the more appropriate for 21st century pedagogy, in a fast changing digital and knowledge age. It is therefore very hard to provide evidence-based guidance to learning communities on the assemblage of spaces that will best support their educational imperatives.

Another key issue is the natural resistance that we have to change and how to facilitate this without leaving members of the educational community behind. Buy-in from the whole community (as far as possible) is necessary for success.

The approach to evaluation suggested in this chapter, and its focus on the special situation of the ESP, provides an opportunity for the development of a unique evaluation framework, one that could be designed as a series of 'reflective' tools to help learning communities (leaders, teachers and students) reflect on the interaction of the school's culture, the educational programs, pedagogical practices and the use of physical spaces. As such, the evaluation would be a formative and participative evaluation framework that should have enough rigour to be also a research tool.

The type of research presented in this chapter would have the following impact. It would identify major successes and failures in the design of physical learning environments and examine the possible interventions to solve problems. It would provide insights into how effectively the learning environments are being used and understand the problem areas. It would help determine teachers' spatial competencies and identify the areas that need to be improved through professional development strategies.

In the process of achieving those three outcomes, it would provide guidance on the planning of new learning environments, and provide learning communities with a tool to determine where they are in terms of pedagogy and space alignment and enable discussion for future practice and/or space interventions

#### NOTES

- <sup>1</sup> In this context, the design team refers to the architects, landscape designers, interior designers, engineers, IT specialists, etc. Often the ESP is considered as part of this team.
- <sup>2</sup> Learning community refers to educators, students, members of the wider community and relevant governing educational bodies.
- <sup>3</sup> The definition of a 'learning environment' often refers to the social, psychological or conceptual environment rather than to the physical (Cleveland, 2011). There is however an increased interest on the role of space in educational settings.

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## EMERGING KNOWLEDGE



*Yarra Valley Grammar School  
Photo courtesy of Hayball Architecture  
Photo credit: Dianna Snape*

KENN FISHER

## 12. EMERGING EVALUATION KNOWLEDGE IN NEW GENERATION LEARNING ENVIRONMENTS

### INTRODUCTION AND CONTEXT

There is a significant gap in learning environment discourse in connecting graduate attributes to affordances such as space, place, technology and pedagogy. Contemporary journals such as the *International Journal of Learning Environments* rarely include critical articles on aspects of the physical environment of learning communities (Cleveland & Fisher, 2014). Given the limited nature of emergent scholarly, peer reviewed knowledge related to the spatially oriented aspects of learning environments, any attempt to establish an effective research methodology to evaluate the impact of the physical environment on pedagogy and learning outcomes poses a significant challenge.

Wes Imms' earlier chapter draws from a number of past evaluation efforts focused around what are now generally considered as a discredited 'open plan' schools project in the 1970's (Rodwell, 1998). This is followed by a detailed analysis of Hattie's (2008) more recent meta-analysis of open plan schools. Imms concludes that evaluations of learning environments are about more than just design; they must also include teacher pedagogical practice if evaluations are to take into account the interactions between both practice and design. Imms identifies four key issues that must be considered in the context of a quality evaluation: change, design, pedagogy, curriculum and metrics.

But what is it that we are evaluating in new generation learning environments (NGLEs)? The continuing use of the term open plan (Waldrip, Cox, & Jin Yu, 2014) continues to be problematic if considered in the context of NGLEs. Alternative terms such as 'learning landscapes' (Lackney, 2015), technology enabled active learning (or TEAL, see MIT, 1999) and active learning classrooms (Whiteside, Brooks, & Walker, 2010; Walker, Brooks, & Baepler, 2011) denote a more nuanced 'take' on the terrains of learning.

Added to this mix is the concept of 'open programs' that implies curriculum and pedagogical practices can be implemented over these open plans. It appears that the term 'open plan schools' emanated from the 'open education' drive in the 1970s (Rodwell, 1998, p. 103). A new conceptual language is needed, one that reflects the breadth of learning programs that can be carried out in spaces which are capable of morphing rapidly and organically to afford the spatial requirements needed to support a wide range of programs, pedagogical practices and curriculum needs.

Such overarching terms as open plan and open programs diminish the importance and impact of student learning styles (Coffield, Moseley, Hall, & Ecclestone, 2004), the rapid rise of mobile online educational technologies (Churches, 2007) and the cultural pedagogical practice of teachers (NCCREST, 2015). Student learning styles need to be considered within whatever pedagogical practice is being utilised (as illustrated in Figure 1). To this end, perhaps terms such as flexible learning spaces, learning commons, or, better still, agile or adaptive learning spaces, are more reflective of the types of spaces required to support changing pedagogical practices and curriculum needs. Coffield et al.’s model (2004) suggests 13 learning types that have been simplified to four (see Figure 1). Within this framework, for example, can be seen the application by Williams, Armstrong and Malcolm (1985) of the Myers Briggs type indicator to the design of spaces to accommodate a range of personality types.

Whilst the Williams, Armstrong and Malcolm study centred around the design of office spaces, it is worth considering how similar innovative design approaches might be applied to open plan learning environments.

<p><i>Genetic &amp; other constitutionally based factors</i></p> <ul style="list-style-type: none"> <li>• Gregorc’s Mind Styles Model and Style Delineator</li> <li>• The Dunn and Dunn model and instruments of learning styles</li> </ul>
<p><i>The cognitive structure family</i></p> <ul style="list-style-type: none"> <li>• Riding’s model of cognitive style and his Cognitive Styles Analysis (CSA)</li> <li>• The Myers-Briggs Type Indicator (MBTI)</li> <li>• Apter’s reversal theory of motivational styles, the Motivational Style Profile (MSP) and related assessment tools</li> <li>• Jackson’s Learning Styles Profiler (LSP)</li> </ul>
<p><i>Flexibly stable learning preferences</i></p> <ul style="list-style-type: none"> <li>• Kolb’s Learning Style Inventory (LSI)</li> <li>• Honey and Mumford’s Learning Styles Questionnaire (LSQ)</li> <li>• The Herrmann ‘whole brain’ model and the Herrmann Brain Dominance Instrument (HBDI)</li> <li>• Allinson and Hayes’ Cognitive Style Index (CSI)</li> </ul>
<p><i>Learning approaches and strategies</i></p> <ul style="list-style-type: none"> <li>• Entwistle’s Approaches and Study Skills Inventory for Students (ASSIST)</li> <li>• Vermunt’s framework for classifying learning styles and his Inventor Learning Styles (ILS)</li> <li>• Sternberg’s theory of thinking styles and his Thinking Styles Inventory (TSI)</li> </ul>

Figure 1. Learning Styles (after Coffield et al., 2004)

Burke (2005, 2014, & in press) has written on related themes around children and the retreat or ‘cubby-like’ spaces they often chose to occupy. Likewise, Abassi’s



(2010) work examines the types of non-formal spaces utilised by secondary students and the need for secluded, focussed work areas where they can work independently of the wide-ranging program of activities. Indeed office design researchers have now moved on from trying to measure the productivity of workers, and are now focusing on the wellbeing of workers (Steelcase, 2015). Such concepts could be applied to measuring the well-being of both teachers and students in school new generation learning environments, as noted in the Well Certification (2015).

Whilst still an emergent area of focus within learning environments research, the examination of human environment relations has been a significant part of health planning research activities for the past two decades (HERD, 2015). For example a meta-evaluation by Ulrich (2005) has shown that the physical environment has a significant impact on the rate of healing of patients in a wide range of contexts. The education sector needs an equally rigorous approach to measurement and evaluation that might well be rooted in the methodologies used by health planners. These are based in turn on clinical research practice extant in medical research.

Indeed the underlying vision and mission of the Melbourne Graduate School of Education (MGSE, 2015) is premised on clinical teaching, so it is a logical step to look at a clinically informed NGL evaluation models and praxis. The MGSE offers a Masters subject that combines pedagogy and learning spaces and is taught across the two disciplines of education and design by Cleveland and Woodman (2015a). This subject requires master of teaching and master of architecture students to use a research-based methodology to jointly design a ‘real’ space in the educator’s school using evidence of what works as a basis for the proposition. This provides a source of emergent knowledge, although the evidence-base may not be as robust as might be needed to provide substantive ‘proof’ that these innovative practices and designs work because of the short cycle of the course and the associated school prototypes.

Another form of emergent knowledge acquisition which engages teachers and designers in the production of NGL’s is an exercise called ‘Stuff It’, an activity created by Cleveland and Woodman (2015b). This exercise requires teachers and designers to organise the planning of an empty floorplan with spaces, furniture, technologies and zones that support innovative learner centred pedagogies. Such innovations as they exist, however, need to be scaled up to have any significant impact on system-wide embedded cultural teaching practices, many of which remain largely rooted in 20thC practice. Teacher learning – or continuous professional development (CPD) – is patchy in many States of Australia and indeed globally, and is often left up to either the individual teacher or the school to organise. Rarely is such CPD organised around new generation learning environments. However, in some schools, teacher professional development is a significant focus. Bissaker (2010) notes that:

In essence the Australian Science and Mathematics School did not just attend to a transformation of traditional science and mathematics curriculum but addressed many factors at once, including school design, organisational

elements of a school day, pedagogical models, explicit engagement with academics and the role of teachers. In supporting teachers to transition from traditional ways of teaching mathematics and science the school leaders provided a major commitment to the provision of high quality professional learning for all teachers. (p. 3)

#### CASE STUDY: THE AUSTRALIAN SCIENCE & MATHEMATICS SCHOOL (ASMS)

This school opened in 2003 in direct response to the then Australian Chief Scientist (Batterham, 2000) advising that the number of students choosing science and mathematics in secondary schools and universities was diminishing. This was impacting on the country's science and related sectors' capacity to carry out world leading research and was also creating a reduction in the number of science-trained teachers – resulting in a cycle of decline in the quality of science teaching. The school was designed around a problem-based curriculum delivery model that is also a feature of medical training in many Australian Medical Schools. In terms of the spatial implications of these moves, Bissaker, Davies, and Heath (2006) noted:

The design of the building moves away from architectural-pedagogical paradigms that reinforce teacher-centred pedagogical practice and define the traditional power relationship between teacher and student. The design of the building's learning spaces is an architectural response to the desired pedagogical approaches at the school. It is designed for highly collaborative and interactive, student-directed approaches that transfer the power of adolescent social interaction into the learning environment. (p. 2)

The school had a mandate to revolutionise the teaching of science and maths and this, in part, was also necessitated by the emergence of the 'new sciences'. These sciences could not be taught in the traditional single subject mode as they were, and are, cross-disciplinary. They include robotics, photovoltaics, nano technology, space science, aeronautics, biosciences and biomechanics. Further, the traditional one-subject laboratory was not suitable for this cross-disciplinary teaching model. In the first decade of the 2000's, complex world problems were rapidly emerging. These included climate change, water and food security, energy conservation, marine degradation and so on, fields that cross many disciplines of science and also the humanities, social sciences, medicine, engineering, economics and law. Thus we have seen the clustering of research bioscience hubs, technology hubs, manufacturing engineering hubs and more which are all raising the need to train our future researchers and knowledge workers to be cross-disciplinary and highly collaborative in their professional practice.

The single subject teacher-centred pedagogies and learning spaces of the 19th and 20thC were – and are – no longer adequate in the 21stC. The starting point for the ASMS was to rethink the teaching model and shape it in the shadow of these research trends. [Figure 2](#) illustrates the key elements of such a transformative model.

The hierarchical and faculty-focussed model was flattened and formed into teams, working groups, industry impact and relationships (leading to the technology schools network) and teacher learning teams all centred around innovative pedagogy and innovative learning spaces. The framework is focussed on ‘contributive’ leadership with all teachers involved in the planning.



Figure 2. The contributive leadership model at the Australian science and mathematics school (Source: ASMS, 2012)

This team-based integrated approach worked towards a thematically delivered curriculum shaped around a problem-based pedagogy within a spatial framework made up of learning commons and learning studios. All of these elements provided an agile and adaptive framework that could, did, and does transform itself to adapt to new and emerging opportunities. Examples of this include two new aeronautical simulation platforms, a robotics studio capability, and various biosciences specialities (in collaboration with Flinders University). At the time of writing, a three-year experimental InnovSpace has prototyped what will become a ‘maker space’ where students can build scale models to test their new sciences learning on authentic problems in the world (ASMS, 2014). In the latter stages of this ‘proof of concept’ a number of collaborative student projects have been highlighted, including rocket powered cars, the study of graphite and its potential uses and some space sciences studies, with 60% of ASMS students learning how to 3D print. The guiding principles of the maker space are ‘if there is interest, learning happens; making is learning; natural interest in technology; knowhow is infectious; and, create conditions for

learning’. One ASMS industry partner has noted, “they have been the only group of school students who decided to completely design a CubeSats from phase zero. Their initiative is a worldwide first in schools’ education and we have been very proud to support them” (ASMS, 2014, p. 24).

The evidence that this school actually works is seen in a number of ways. The students show all visitors around the school, explaining how the spaces work. 90% of students gain access to university programs on graduation. Student testimonies are videoed and are available on the ASMS website. The school is also one of the most visited in Australia, by local, national and international teachers, and by educational administrators, designers and others.



*Figures 3 & 4. ASMS students collaborating on the design of a science and technology-based game and student project on rocket powered cars (Source: ASMS, 2014)*

#### EMERGENT KNOWLEDGE – METHODOLOGY AND METHODS: A REVIEW OF POST 1999 NGL E EVALUATIONS

In seeking to source examples of new and emergent knowledge, Fisher and Newton (2014) evaluated a range of peer reviewed NGL E evaluation studies written in the period 2007–2012. Four that could be considered worthy of consideration of quality scholarly research studies in this field were selected. Subsequently Fisher and Ellis (in press) evaluated additional peer reviewed journal articles published after 2012. They found another four studies worthy of bringing to the attention of researchers. The following sketches some of the key findings of these studies.

By way of a genealogy of learning spaces development (Foucault, 1979), one of the earliest attempts at codifying emergent knowledge in learning environment design was initiated by MIT (1999) in Physics 1 which had very large classes in the programme. It was successfully transferred from the lecture theatre to an active learning classroom model. Subsequently, Sanoff (2001) developed a school building environment ratings survey instrument based around the Likert scale. While no significant comparative results appear to be available, the tool is a robust attempt at developing emergent knowledge of school design alternatives. Later there was an increase in interest around NGL E’s initiated by Educause (Oblinger, 2006) and JISC

(2010). Both agencies had previously engaged largely in ICT and learning, but were finding that the spatial dimension remained unchanged whilst technology evolved at a rapid rate alongside these largely static 20thC learning environments.

In the USA, Whiteside, Brooks, and Walker (2010), explored a ‘before and after’ scenario by comparing a traditional teacher-centred classroom with an NGLE space.



*Figures 5 & 6. Industrial age ‘before’ and NGLE ‘after’ classrooms  
(Source: Whiteside et al., 2010)*

They surveyed 13 groups of 9 students in a TEAL (technology enhanced active learning) space and found that there were clear increases in student grades – compared with the traditional classrooms – of 7%. At the same time, key activities in the active classroom included increased group activity, a higher level of engagement between individual students and the teacher, and less teacher centred direct instruction.

Yet another study (Barrett, Zhang, Moffat, & Kobbacy, 2013) focussed in particular on indoor environment quality (IEQ) and its influence on primary school learning outcomes. An environment-human-performance (EHP) model was developed and incorporated within ten design characteristics framed around three design principles (refer to [Figure 7](#)): *naturalness* (light, sound, temperature and air quality); *individualisation* (choice, flexibility, connection); and *stimulus* (complexity, colour and texture). Of these ten, six were found to have a high influence – i.e. colour, choice, connection, complexity, flexibility and light. Seven primary schools were selected in the UK with 751 pupils occupying 34 classrooms. Tested over one year, the model concluded that the environment did affect students’ learning outcomes and, through a multivariate analysis, it was estimated it had an influencing factor of 25%. The study ‘nested’ the results as Level 1 pupil factors (which had high individual variance due to student demographic backgrounds), with the Level 2 class factors having a much lower variance (73% reliability) as they were related to the six school design parameters. Barrett et al. (2012) also acknowledged that there was no measure for teacher effects that could influence the results significantly. This writer finds this a major flaw in this study. However, the process is useful in terms of the attempt to coordinate the three key characteristics of naturalness, individualisation and stimulus, which can inform NGLE design processes.

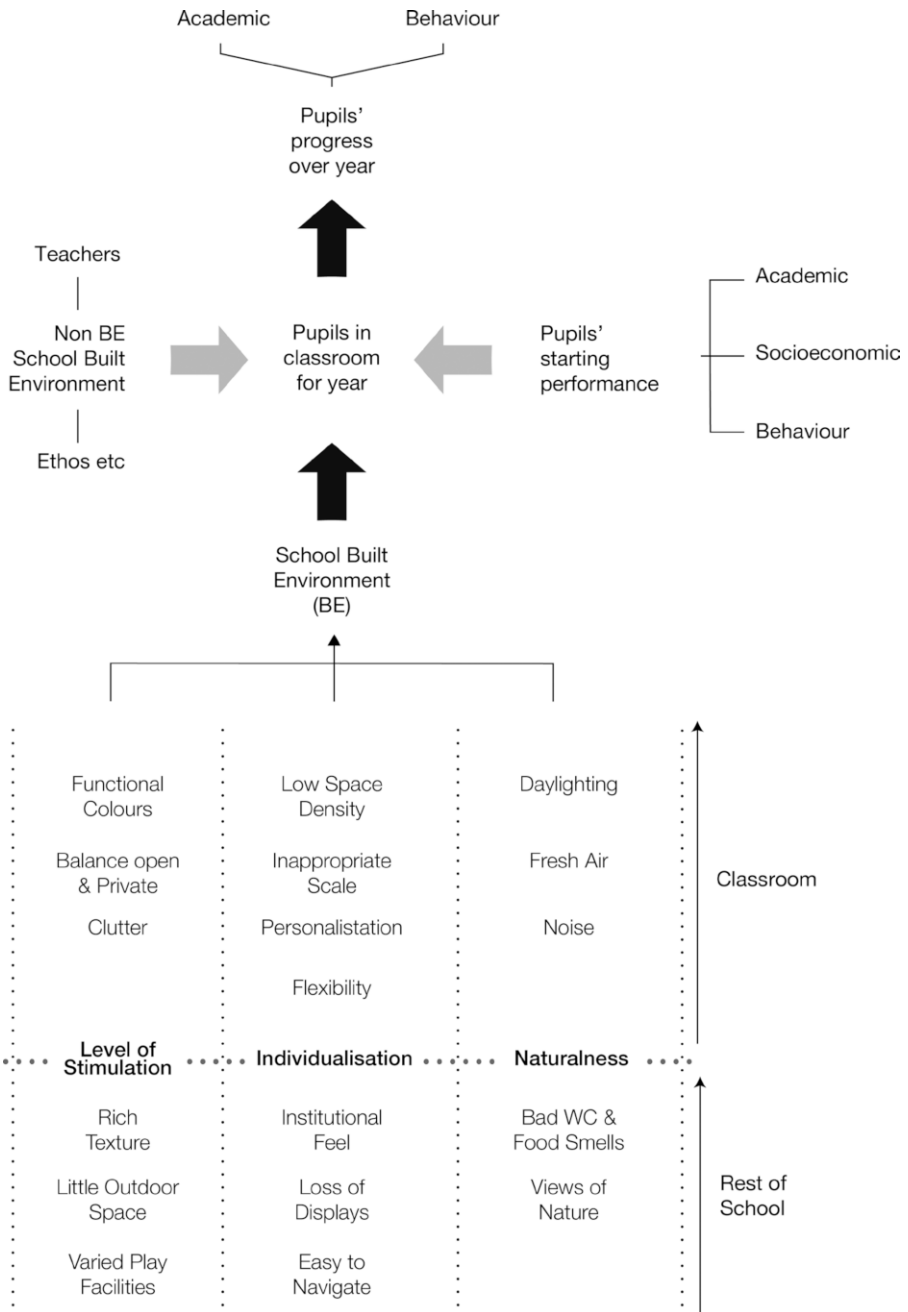


Figure 7. Diagram of research design parameters (Source: Barrett et al., 2012)

A study at university level by Brooks (2012) examined 55 key learning activity factors with 5-minute observational reviews of what was happening in the active learning space. This was supported by subsequent student survey questionnaires, interviews and focus groups to cross-reference and triangulate the findings. Brooks used four variable clusters: activities, modes of instruction, teacher behaviours, and student behaviours. This is the most significant survey seen thus far by this writer and is a model for future studies. Brooks (2012) notes that “in general terms, we have provided empirical evidence of a causal relationship that can be stated best in syllogistic terms: (1) space shapes instructor behaviour and classroom activities; (2) instructor behaviour and classroom activities shape on-task student behaviour; therefore, (3) space shapes on-task student behaviour” (p. 10).

Two years later, Prain, Deed, Edwards, Farrelly, Keeffe, Lovejoy, Mow, Waldrip, and Yager (2014) combined a range of factors impacting on school design as illustrated in Figure 8. This study examined the complexity of a regeneration project that witnessed schools’ return to a modified ‘open plan’ – preferably redefined (see earlier discussion) as a contemporary blended-learning environment. Three schools were tracked from their original traditional classrooms practice from 2008 to their new site in 2012 with the results showing clear increases in numeracy and literacy. These were measured using Naplan tests and these results showed how the schools had moved up the rankings. The complexity surrounding the transformation from a teacher-centred classroom model to a learner centred learning neighbourhood model was illustrated in this study.

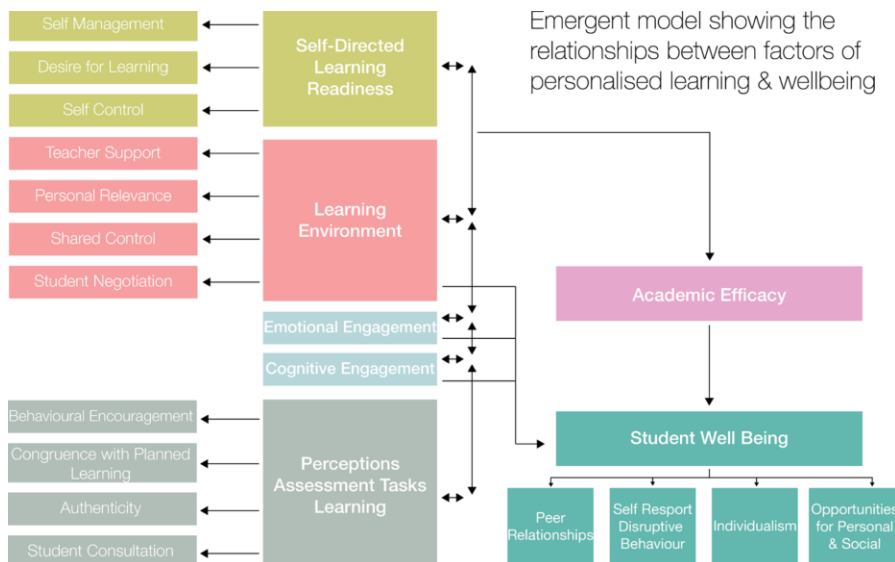


Figure 8. Factors impacting on the design and evaluation of an NGL  
(adapted from Prain et al., 2014)



In 2014 Freeman, Eddy, McDonough, Smith, Okoroafor, Jordt, and Wenderoth when exploring science, technology, engineering and mathematics (STEM) learning environments, argued that there was evidence demonstrating that the lecture mode of curriculum delivery was providing diminishing learning outcomes. If the teaching of science was to be based on evidence – which is the fundamental basis for the epistemology of science – then shouldn't STEM teaching be looking at alternatives to the lecture mode of delivery? They evaluated 225 published and unpublished evidence-based articles on teaching STEM in NGLÉ's where

the active learning interventions varied widely in intensity and implementation, and included approaches as diverse as occasional group problem-solving, worksheets or tutorials completed during class, use of personal response systems with or without peer instruction, and studio or workshop course designs. (p. 1)

They found that students were 50% more likely to fail if attending a lecture-based programme than if they attended an active learning based programme.

In another study Baepler, Walker and Driessen (2014) investigated where lectures were delivered online with students having 1/3rd less staff contact time. They engaged with the material with peers and teachers in an active classroom, and in effect the process modelled the emerging flipped classroom approach. They found that:

[in] an active learning classroom, student faculty contact could be reduced by two-thirds and students achieved learning outcomes that were at least as good and, in one comparison, significantly better than those in a traditional classroom. Concurrently, student perceptions of the learning environment were improved. (p. 227)

Another largely quantitative study by Scott-Webber, Strickland and Kapitula (2013) used measures of student engagement (National Survey of Student Engagement, 2011) in three different active classroom layouts (ACL) compared against a fourth traditional all-seats-facing-the-front model. Whilst Jankowska and Atlay (2008) have shown that student engagement links to learning outcomes, the authors used brain science (Jensen, 2005) and brain-compatible classrooms (Erlauer, 2003) as additional sources of supporting evidence regarding the impact of an active learning engagement. Thus four aspects were measured – behavioural, psychological, socio-cultural and holistic. In noting that there are many other possible variables, the authors stated that:

However, in attempting to establish a relationship between the designed environment and the behavioural factors of student engagement, it is important to develop a body of evidence that establishes a foundation for the idea that the learning environment impacts student behaviours. (Scott-Webber, Strickland, & Kapitula, 2013, p. 2)

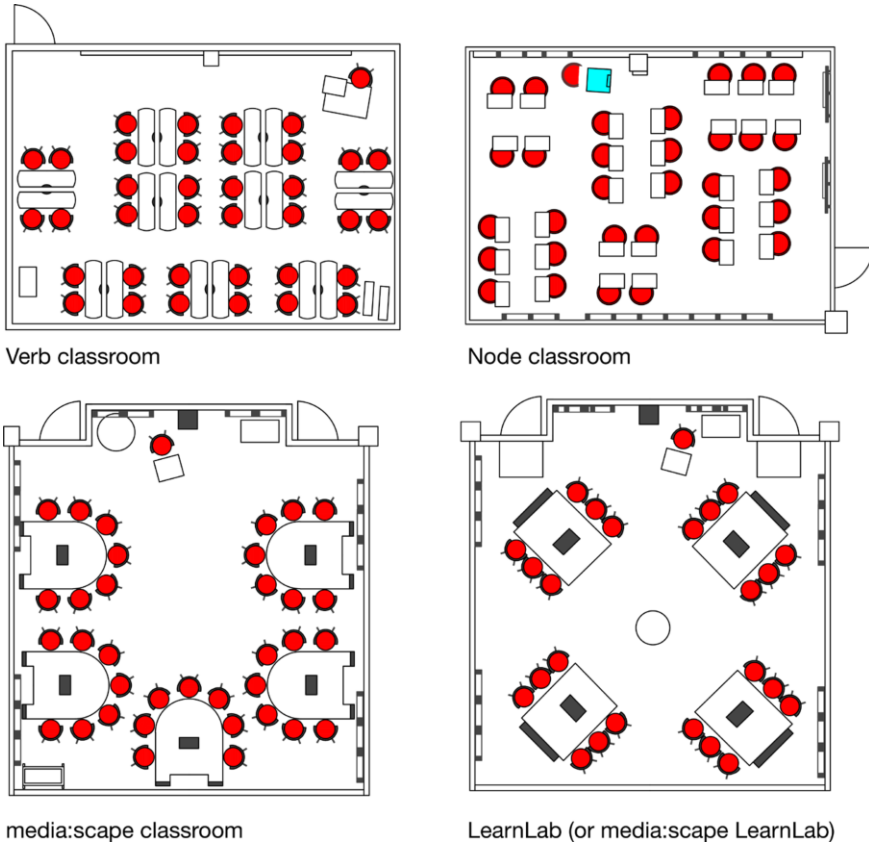


Figure 9. Steelcase 'Solutions' for four typologies (Source: Scott Webber et al., 2013)

There were three parts in the Scott-Webber et al. project (2013). Firstly, the demographics and baseline were established – i.e. the educational level of the student, type of course, type of ACL instructional approach and perceived level of engagement. Secondly, learning practices and solutions were evaluated using 12 identified student engagement factors which included collaboration, focus, active involvement, opportunity to engage, repeated exposure to material through multiple means, in-class feedback, real-life scenarios, ability to engage ways of learning best, physical movement, stimulation, feeling comfortable to participate, and the creation of an enriching experience. The learning practices were replicated in the three ACL's and the fourth traditional space to measure the extent of student engagement. The final stage was a 'perception of outcomes' questionnaire in which students responded re the 'old' and the 'new' to levels of engagement in class, grade achievement, motivation to attend plus an open-ended comments.

Validation of the results was through an established psychological testing process. Over 90% of students found the three ACL prototypes:

provided adequate or better engagement and support of classroom practices. Most rated the engagement factors higher or better than the traditional. Teaching practices scored 36.3 out of 48 in the ACL, and 21.6 in the traditional. 80% rated a better ability in achieving a higher grade in the ACL's, and 78% had increased motivation. (Scott-Webber, Strickland & Kapitula, 2013, p. 6)

These findings correlated with teacher perceptions. Although the researchers noted some limitations in the study, they believed that this evidence-based evaluation was valid and that such research methods should be precursors to all new NGLÉ's and that the environment does impact on student behaviour.

A newly released book looking at school design through architectural psychology (Walden, 2015) sets out what is effectively a checklist for school design. However, it does not seem to take an evidence-based approach to its work. That said, it is worth highlighting what it notes about the design of schools:

Our real illiteracy is not the ignorance to read and write and not the incapability to repeat other people's knowledge, but the inability to create. A child possesses this creative ability; the seemingly illiterate seemingly ignorant child is not ignorant and not illiterate at all. On the contrary it (sic) is in full possession of his (sic) own creative powers .... (Hundertwasser as cited in Walden, 2015)

Hundertwasser was most likely the instigator of contemporary biophilic design, much of which does have an evidence-base drawn from health planning environmental design research mentioned earlier in this chapter.

#### EMERGING KNOWLEDGE IN LEARNING ENVIRONMENT EVALUATION

The three following chapters in this section on emergent knowledge epitomise the efforts now taking place to further develop the scholarly evidence-based literature on new generation learning spaces.

Barry and Raftery examine the built forms supporting the new Junior Cycle in Irish schools (JCSA) and find them wanting. They argue that the over-proscriptive space planning and furniture design guidelines of the Governing Department need to be reviewed to enable a much more relevant learning environment design in support of the new JCSA pedagogy and curriculum innovations. These new designs should also be supported by extensive teacher professional development in new generation learning environments (including online), and that teachers should be involved, along with students, in the design of new primary schools. The existing rigid and proscriptive space planning guidelines do not allow for future changes in pedagogy and curriculum

Soccio focuses on the technical performance of the learning environment. Research has consistently shown that poor acoustics, temperature control, artificial

and natural lighting, air flow and materials selection all impact on the wellbeing of staff and students Ulrich, Quan, Zimring, Joseph and Choudhary, 2005). Soccio's studies are replicated across many schools in Victoria with very telling results. Indeed, we must make sure that the environmentally sustainable design features installed in schools are not redacted through teachers resisting the move towards NGLÉ's by closing up their new energy efficient designs and people efficient spaces as has occurred in too many schools to date.

Dane has developed a learning environments evaluation model that takes account of technical features, information technologies, educational technologies, furniture, pedagogical affordances and other factors. This 'tool' is in the process of being rolled out on a range of learning spaces and will provide outputs that can be comparable in terms of the various elements being measured. It will enable a deeper analysis and understanding of what works and why, and importantly what is needed to update the existing 20thC learning environments estate we must deal with.

These three Chapters are just a Snapshot of what is currently being undertaken in terms of qualitatively based evaluation methods at the University of Melbourne. They contribute to emerging knowledge on the scholarly evaluation of new generation learning environments research and will help to inform new designs, new teacher practices and supplement – in a timely way – the emergent knowledge base in NGLÉ's as the school estate is brought up to contemporary standards at a very significant cost. We should have appropriate knowledge on which to base these designs so the investment is not wasted on new 21stC replicas of 20thC schools which are increasingly being proven by researchers to be inadequate for today's learners.

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### **13. A NEW CURRICULUM AND A NEW LEARNING SPACE**

*An Opportunity for Real Change in an Irish Context*

#### CONTEXT

Curricular change is currently underway in Ireland. A new Junior Cycle Student Award (JCSA) marks a move away from traditional learning and examinations, replacing these with project work, continual assessment, and collaborative styles of learning (Flynn, 2012, October 4). Traditionally, teaching and learning has been dominated by teacher-led methodologies. Students sit in straight rows of square individual desks facing a whiteboard and projector at the front of the classroom. The teacher lectures on their subject expertise and the students write notes, with limited peer interaction. However, the foci of the JCSA are team work, discussion, project design, and collaboration and these will change the dynamic of classrooms, and improve the communication skills of pupils. This kind of change presents an excellent opportunity to reconsider classroom spaces and how they are used, with a view to designing new learning spaces to accommodate the curricula innovation (Fisher, 2005a).

Ireland has for many years used curriculum reform as an accelerant for the adoption of learner-centred pedagogies in teaching and learning (National Council for Curriculum and Assessment, 2011). However, schools have experienced difficulty moving away from past pedagogical cultures to adopt new approaches to teaching and learning (Chism, 2006). If the traditional learning spaces in schools are not reconfigured to allow for collaborative work is it reasonable to predict that the new approaches of the JCSA are doomed?

In Ireland, school designs for State-funded school buildings are contained in a set of guidelines from the Department of Education and Skills (DES). The DES insists that “where it is proposed to construct a new school these guidelines and all associated documents in the suite of Design Guidance should be applied in full” (Department of Education and Skills, 2014). The design philosophy of the DES states that “the different functions of the ‘Design Team’ members shall be integrated, combining ‘Building Services Engineering’, ‘Architectural Design’, ‘Structural Engineering’ and ‘Quantity Surveying’ to create a well-designed, sustainable, cost effective, durable low maintenance building” (Department of Education and Skills, 2014). Notably missing in this ‘team’ are the teachers, principals and pupils. This



study suggests that teachers and principals have a key role to play in informing good design for learning spaces and they should play a central role in evaluating innovative learning spaces.

Spaces need to be responsive to evolving educational programs, philosophies, delivery methodologies, and student and staff needs (Chism, 2003; Cleveland, 2011; Fisher & Dovey, 2014; Rydeen, 2013). The main purpose of the study described in this chapter was to determine what ‘works’ for teachers in newly designed innovative spaces by exploring how the spaces respond to the needs of students and teachers. The study also attempted to investigate whether innovation in the design of school learning spaces might be an “interventionist strategy with the potential to catalyse sustainable pedagogical reform” (Cleveland, 2009, p. 20). The findings of this study indicate that there are strong arguments for reconsidering the design and configuration of learning spaces, to promote teaching and learning methodologies associated with the introduction of the JCSA in Ireland. These findings can inform the design practices of architects designing learning spaces in Ireland and meaningfully considered during the education of pre-service teachers. Considering modifications to school spaces is both necessary and opportune at the introduction stage of the JCSA.

#### OBJECTIVES

The objectives of the research were to:

- examine *the use of space* during teaching and learning episodes over a defined period of time with one First Year group (age: 13 years)
- determine the *attitudes of teachers* towards teaching and learning in the innovative space
- discover the *perceptions of teachers* with regard to the social interaction of students in the innovative learning space
- determine factors and *implications for the future* in learning space design, in the context of Irish second-level schools

#### METHODOLOGY AND DATA COLLECTION

The methodology and data collection approaches selected for the research were informed by both the research question and theoretical perspectives from current national and international literature. The research, which comprised a study of one school, was conducted over an eighteen month period. An interpretivist approach was adopted, and the views of the school ‘users’ (Principal and teachers) were privileged in the analysis. Interpretive research strives to understand and interpret the world in terms of its actors (Cohen, Manion, & Morrison, 2011). The adoption of an interpretivist approach required the acceptance of value-mediated findings and a subjective view of the learning space in question (Cohen, Manion, & Morrison, 2011). The writer was aware that all the interpretations were based in a particular moment, i.e. after teaching and learning periods had occurred in the learning

space. The interpretations were open to re-interpretation and negotiation through dialogue between the researcher, the Principal and the five participating teachers. An interpretivist approach was appropriate for this research because it was in keeping with the focus on the relationship between the learning spaces and teacher’s experiences of teaching and learning for the JCSA in this space.

‘Burrow College’ is the pseudonym given to the school that participated in the case study. It was a pilot school for the JCSA, and a space had been adapted to allow flexible working and creative learning. To assess teachers’ responses to this space, the research study was approached in a holistic manner, and descriptions, photographic records and audio journals were collected to explore learning episodes within learning spaces. These documents facilitated the chance to understand the perceptions of the individual teachers involved. The difficulties with validity when conducting the research in a single culture were known, however, it was believed that this was compensated for by the wealth of experience and variety of subject specialisms of the Principal and the five teachers who participated in this research. While this research focused on one pilot school, future research may consider using multiple schools to allow for comparisons across multi-cultural contexts.

The research was conducted within the University College Dublin ethical framework and guidelines. To commence the research, an assessment rubric for learning spaces in Ireland, was created, drawing on the following documents: *Principles of Teaching and Learning* (NCCA, 2011); *An emerging template for assessing learning spaces* (Narum, 2013) and Fisher (2005b), *Linking Pedagogy and Space*. The learning space assessment rubric was named the ‘POLTSAR’ tool (see Appendix A). Fisher (2002) divided active learning methodologies into five areas: delivering, applying, creating, communicating and decision making. These five areas were incorporated into the ‘POLTSAR’ tool to assess the learning space. The tool determined the implications that the ‘Principles of Teaching and Learning’ of the JCSA curriculum had on learning space design and configuration. For example, the creativity and innovation section of the POLSTAR tool is illustrated in [Figure 1](#).

<p><b>Creativity and Innovation</b></p> <ul style="list-style-type: none"> <li>• Learner centred pedagogies with multiple learning settings co-located</li> <li>• Theory linked to practice, problems integrate both aspects, resources used continually and creatively, integrated curriculum delivery</li> <li>• Students encouraged to participate in learning space design and learning space reconfiguration</li> </ul>	<p><b>Provisional space that is in a state of flux</b></p> <ul style="list-style-type: none"> <li>• Multi-purpose learning zones that enable students to learn through inter-disciplinary short courses over a period of time</li> <li>• Wet area</li> <li>• Facilitates team teaching</li> <li>• Opportunities to move around</li> </ul>
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*Figure 1. The learning space provision for creativity and innovation*

To collect data, audio journals were used. It was hoped they would capture instantaneous responses from teachers using the innovative learning space in Burrow College. The teachers were asked to facilitate teaching and learning in the space, record a post-lesson audio journal, and indicate how the physical learning space affected the teaching and learning episode. The use of audio journals gathered instantaneous, naturally occurring data from the teaching and learning episode that took place in the physical learning space.

Photographic records were created by the five teachers. Photographs are useful sources of data because they can convey the culture, background and ‘biographies’ of an event. An image can also give insight into behaviour, as photographs are “wrapped in many layers of meaning and interpretation” (Cohen, Manion, & Morrison, 2010, p. 554). The photographs were analysed in a similar way to the interviews and audio journals. Thematic analyses of both the recordings and the images were made, with reference to the ‘POLTSAR’ tool. The themes were grouped together and a statement regarding each theme was produced in the analysis. The research question was then addressed using these themes. By employing the use of photographs, data that not only described events in context, but participants’ intentions, strategies and agencies (Cohen, Manion, & Morrison, 2010) were generated.

#### OBSERVATIONS

The 260m<sup>2</sup> learning space was designed to enable a full cohort of sixty students and two teachers to gather for the purpose of teaching and learning. There were two learning zones: ‘Learning Zone A’ (180m<sup>2</sup>) and ‘Learning Zone B’ (80m<sup>2</sup>). The zones were linked by a moveable partition and had matching floor finishes. The learning space could also be set up for large-group activities, facilitating events such as presentations from a guest speaker, or for hosting a school assembly. Zone A was designed as a general purpose area. Adhering to the technical guidance documents of the Department of Education and Skills (DES), the space contained a stage, a mounted projector, table and bench units (see [Figure 2](#)). These units were 1825 mm long with a seat height of 425 mm and a table height of 740mm. There were also hexagonal tables, chairs, a demountable stage (800 mm in height), a projector screen, acoustic sound panels and white walls.

Zone B was designed as a Music/Drama room that adhered to the technical guidance documents of the DES. It contained student tables (600 x 600 x 760 high), a teachers’ desk (1200 x 600 x 760 high), 30 student chairs (460 high), a teachers’ chair (460 high), a whiteboard (2400 x 1200), a pin board (1200 x 1200), an ‘Interactive Whiteboard’, an electronic projector screen, a projector, and white walls. It also linked to the outside, natural world at the front of the school through double doors and a storage press (900 x 450 x 1800 high). Diversity in the range of zones within the learning space allowed the space to be clearly different from the traditional classrooms at Burrow College (see [Figure 3](#)).



*Figure 2. Table and bench units, as per the technical guidance document from the Department of Education and Skills (DES). Burrow College, March 2014*



*Figure 3. The traditional classrooms turn into a new learning space. The traditional classrooms at Burrow College were turned into the larger, brighter General Purpose room and the Music/Drama room with two learning zones. Burrow College, March, 2014*

In line with DES technical guidance documents the moveable partition created smaller learning zones that proved to be a successful design feature as the partition provided an opportunity to create two learning zones.

While teachers were keen to use the new spaces, they pointed out that a lack of continuing professional development (CPD) was a major barrier to both creating and using learning spaces. There is very limited CPD available for teachers on learning space design and configuration in Ireland. The Board of Management, the Principal, the teachers and the students were not engaged in the school design process. Indeed, the omission of key stakeholders is a weakness in the school design process in Ireland. The Principal provided an insight into his experience with the technical guidance from the DES that he was able to change only a little. The equipment lists, including the desks, supplied by the department did not lend themselves to flexibility. He lamented that the school would have to fund any changes to the learning space design and furniture (Principal, Burrow College, 2014).



Figure 4. Room layout as specified by the DES for Burrow College, May 2014.  
Source: Technical Guidance Second Level Schools (DES, 2014)

The design philosophy of the DES is that the layout of learning spaces is of critical importance; however, their layouts are those of traditional classrooms, with rows and a teacher’s desk at the front (see Figure 4). However, with some creativity, it was possible to reconfigure the DES design of the General Purpose room and Music/Drama room, resulting in a learning space that facilitated active learning with minimal cost. Even these limited alterations had positive results. The large open spaces allowed for break-out areas for group work in the zones that contained hexagonal tables. The large open spaces also facilitated the teachers to gather the students for communal activities. The partitions, the hexagonal tables,

benches, the stage, and the room configuration were all visible cues for teaching and learning intentions in the learning space. The learning zones in the learning space were readily inter-connected and allowed for a ‘flow of learning’ (Oblinger, 2006; Lippman, 2010).

## CONCLUSIONS

These observations suggest that innovative configurations of learning spaces in second-level Irish schools should be prioritised during new school building projects and curriculum reform. The research found that the learning space influenced the pedagogical approaches and actions of the teachers and the learning behaviours of the students.

Classroom planning and construction in Ireland reflect dated paradigms of teacher-led instruction. Irish second level schools are designed according to specifications from the DES, and include features such as horizontal and vertical circulation routes to separate classrooms. These do not facilitate the *Principles of Teaching and Learning* (NCCA, 2011) of the JCSA. Journals, photographic records and observations indicated that the Principal and teachers in this study lamented the imposition by the DES of rigid guidelines and furniture specification of school design. Even with moderate opportunities for creativity, teachers used learning spaces effectively and enjoyed the process. The teachers encouraged the use of innovative spaces but they also supported the traditional educational objectives of knowledge acquisition and comprehension of subject matter and academic excellence. The learning spaces provided a place for students to share prior knowledge from a range of subjects, to manage information, and to communicate knowledge effectively.

Educators, stakeholders and architects need to re-think learning spaces and the opportunities that they provide. Students require facilitation of inquiry models and collaboration by their teachers and rich tasks to challenge them. These skills can be promoted when learning spaces are designed with environmental cues as to what should or could happen there. The Principal of Burrow College argued that: “skills around problem solving, collaboration, communication ... are hugely important and they are identified in national studies ... in terms of what are the future skills needed in Ireland.”

### *Recommendations*

In Ireland, the DES claims to have a good learning space design process in place for schools. However, no funded large-scale studies have been conducted to assess learning space design practices in any schools across Ireland. The DES Planning and Building Unit and the Inspectorate are currently undertaking a ‘Post-Occupancy Evaluation’ (POE) of recently-built primary schools. Well-defined and documented measurement techniques, beyond the scope of the POE, need to be developed and implemented in the Irish context. Large-scale studies on learning spaces could

provide educational stakeholders with a detailed account of the state of the nation's learning spaces. Irish teachers and architects in each school context require the opportunity to collaborate around the needs of their school context during the school design process. In addition, the impact of learning spaces on teaching and learning in Ireland needs to be investigated. Such studies could provide baseline data needed to advance learning space design during a time of curriculum reform.

With Junior Cycle curriculum reform ongoing, it is important to develop assessment techniques and tools that help educators learn more about the connections between teaching practices, student experiences and learning spaces in the Irish education system. By assessing learning spaces, valuable insights into teaching and learning practices in the Irish context could be documented. Principals and teachers need to take responsibility for the resources and classrooms at their disposal.

The 'POLTSAR' tool, developed through this research could be used to begin to assess current and future learning spaces. Learning spaces should be designed and re-configured to creatively meet the needs of curriculum reform and associated new teaching practices. The writer's review of the tools available to assess learning spaces highlighted a predominant focus on the physical features of the learning space rather than matching the learning space with the teacher practices (Cleveland & Fisher, 2014, p. 25). The 'POLTSAR' tool attempts to bridge this gap, by focusing on the alignment between the learning space and teaching practices. This supports the views of Fisher and Cleveland (2014) who maintain that:

The need for learning environment evaluation stems from a desire to collect evidence that can inform future decisions. Information gained through the building evaluation could be used to inform decisions about both the design and the use of learning environments. For example, the evaluation of new building typologies could inform architects about the effectiveness of new design patterns, while simultaneously informing teachers and students about how they might best utilise new environments to suit pedagogical approaches. (Cleveland & Fisher, 2014, p. 7)

The DES should consider introducing an interdisciplinary approach to the assessment and evaluation of learning spaces. Cleveland and Fisher maintain that it just 'might provide the developmental space needed to generate new knowledge' (Cleveland & Fisher, 2014, p. 24).

Currently, the majority of school buildings adhere to a common design process and model. These learning spaces will not support the JCSA curriculum reform and are out of date even as they are being built. This means they will require future retrofitting (Pearlman, 2010) into contemporary learning spaces. The DES should evaluate its school-design process and room layout technical guidance documents, in order to respond to the needs of Irish schools during curriculum reform. The addition of teachers, students and Principals to the design team would be beneficial.



Every school context requires different learning space designs, and there is a need for flexibility and autonomy in relation to the furniture requirements on the technical guidance documents. A robust furniture budget allocated to the school would give the school autonomy to choose its furniture and fittings to suit its individual needs, vision and values.

The DES should create and implement continuing professional development (CPD) for teachers and Principals in relation to learning space design and its relevance for curriculum reform. These CPD courses could marshal the strengths of both architect and teacher education programs, to evolve innovative learning opportunities for educators. Online professional learning communities, working on learning spaces, could collaborate and share ideas from country to country, while removing the barrier of geographical distance.

Finally, teachers need to be educated on how to engage students in learning space design. In Ireland, curriculum reform is imminent and it will be important to remember that ‘spaces are themselves agents for change and changed spaces will change practice’ (JISC, 2006, p. 32). New learning spaces are symbols of overall change in a school. In the Irish context there is huge scope for further research which aims to enhance the quality of teaching and learning spaces.

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APPENDIX A: ‘POLSTAR: A LEARNING SPACE ASSESSMENT TOOL’

<i>The POLSTAR Junior Cycle Learning Space Design Tool</i>	
Principles of Teaching and Learning  <i>Pedagogical Approach and Professional Actions</i>	Pedagogical Activity and Key Skills  <i>Implications for the Learning Space Design</i>
Applying Managing Information and Thinking Communicating Working with Others Creating Being Creative Delivering Decision Making Staying Well Managing Myself Recognises and supports	
<p style="text-align: center;">Quality</p> <ul style="list-style-type: none"> <li>• Integrated, problem and resource based learning</li> <li>• High expectations and challenging learning objectives</li> <li>• Facilitating and planning for a range of learning styles</li> <li>• Incorporating Bloom’s Taxonomy into active learning tasks that have explicit purposes</li> <li>• Reflective of up to date educational literature and research</li> <li>• Reflects attention to educational research on how students learn, as well as to evidence from the field about what works</li> <li>• Teacher as a facilitator</li> <li>• Team planning and professional dialogue for inter-disciplinary short courses</li> </ul>	<p style="text-align: center;">The educational values and principals of the learning community (teachers, school Principal and stakeholders)</p> <ul style="list-style-type: none"> <li>• Space naturally facilitates interactions, within and between groups and individuals.</li> <li>• Teachers can easily move between groups and use a variety of teaching methods</li> <li>• Spaces facilitate blended learning, reflect the concept of the ‘flipped classroom,’ in which ‘passive’ learning takes place in other times and places.</li> <li>• Furniture movable, adaptable by students/teachers in the use of different types of active pedagogies (small round/hexagonal tables, benches, stools and lightweight chairs)</li> <li>• Adjustable lighting</li> <li>• Air temperature control</li> </ul>

<p style="text-align: center;">Creativity and Innovation</p> <ul style="list-style-type: none"> <li>• Learner centred pedagogies with multiple learning settings collocated</li> <li>• Theory linked to practice, problems integrate both aspects, resources used continually and creatively, integrated curriculum delivery</li> <li>• Students encouraged to participate in learning space design and learning space reconfiguration</li> </ul>	<p style="text-align: center;">Provisional space that is in a state of flux</p> <ul style="list-style-type: none"> <li>• Multi-purpose learning zones that enable students to learn through inter-disciplinary short courses over a period of time</li> <li>• Wet area</li> <li>• Facilitates team teaching</li> <li>• Opportunities to move around</li> </ul>
<p style="text-align: center;">Engagement and participation</p> <ul style="list-style-type: none"> <li>• Project and resource based learning on practical problems</li> <li>• Challenges and supports to develop deep levels of thinking, adventure and application which explore the boundaries of what is known</li> <li>• Facilitation of engagement, construction of personal and peer knowledge and re-evaluating personal and peer knowledge</li> <li>• Facilitation of active engagement of students with their peers in shaping the learning of all</li> <li>• Opportunities to practice communicating, critiquing, skills, competencies and ways of thinking and doing in professional fields</li> </ul>	<p style="text-align: center;">Access to shared break out areas with multi-media to support authentic learning in mixed ability groups</p> <ul style="list-style-type: none"> <li>• Flexible and moveable projector with several projection areas / several mini projectors.</li> <li>• Technologies enable sharing between groups</li> <li>• White boards and/or SmartWall paint walls and surfaces enable learning within groups, peer teaching and brainstorming</li> <li>• Stage</li> <li>• Small, portable three tiered platforms</li> </ul>
<p style="text-align: center;">Continuity and Development</p> <ul style="list-style-type: none"> <li>• Continuous assessment of learning, utilising a pedagogy of assessment</li> </ul> <p style="text-align: center;">Learning reflections and learning logs</p> <ul style="list-style-type: none"> <li>• Developing a tolerance of ambiguity and opportunities for students to asks new questions</li> <li>• Pedagogies that scaffold and facilitate the transfer and application of knowledge and skills</li> <li>• Common understanding of the learning as preparation for life</li> <li>• Opportunities to assess, reflect and build on prior knowledge-Reflect openness in relation to the de-construction of hierarchical structures</li> </ul>	<ul style="list-style-type: none"> <li>• Evidence of the community in the learning space</li> <li>• ‘The Wall of Fame’</li> <li>• Dedicated evidence of learning wall for showcasing student work and progress</li> <li>• ‘Learning Log Wall’</li> <li>• Aesthetically pleasing and links to the natural world</li> <li>• Flexible, agile and responsive to the changing needs and desires of students</li> </ul>

<p style="text-align: center;"><b>Wellbeing</b></p> <ul style="list-style-type: none"> <li>• Contributes directly to their physical, mental, emotional and social wellbeing and resilience.</li> <li>• Peer to peer learning</li> <li>• Formative feedback</li> <li>• A climate of interaction focused on collective wellbeing of all in the learning space</li> </ul>	<ul style="list-style-type: none"> <li>• Safe and comfortable</li> <li>• A Quiet space with soft furnishings</li> <li>• Bright and colourful</li> <li>• Comfortable</li> <li>• Sense of identity and belonging</li> <li>• Silent headphone reflection zone</li> <li>• Link to an outdoor learning space</li> <li>• Individual break out pods</li> <li>• Informal meeting area</li> <li>• Student home base</li> <li>• Could be set up for communal needs</li> </ul>
<p style="text-align: center;"><b>Choice and Flexibility</b></p> <ul style="list-style-type: none"> <li>• Range of subjects and interdisciplinary short courses designed by the facilitators to meet the needs of students in each school context</li> <li>• Encourage the serendipitous collision of ideas</li> </ul>	<ul style="list-style-type: none"> <li>• Students can book access to teachers</li> <li>• Learning spaces that encourage cross-disciplinary teams of teachers working with groups of students</li> <li>• Students can choose their learning zones</li> <li>• Studio zone- ‘Become a Pro’</li> </ul> <p>Link to staff room</p> <p>Adjustable, angled desk</p> <p>Quick, clear transactions can be made from one zone to the others</p> <p>Teacher can move around and interact with the learners</p>
<p style="text-align: center;"><b>Inclusive Education</b></p> <ul style="list-style-type: none"> <li>• Student’s needs, backgrounds, perspectives and interests are reflected in the learning programme</li> <li>• Address problems that are of meaningful importance to the world beyond the school</li> <li>• Promote a social and supportive community</li> </ul>	<ul style="list-style-type: none"> <li>• Design reflects community diversity, respects and values different cultures</li> </ul>
<p style="text-align: center;"><b>Learning to Learn</b></p> <ul style="list-style-type: none"> <li>• Facilitates students as agents of their own learning</li> <li>• Promotion of interdependence, independence, empowered independent learners and self-motivation</li> <li>• Facilitate adventure, opportunities to reflect on their own learning, ambiguity, boundaries and limits</li> </ul>	<ul style="list-style-type: none"> <li>• Breakout spaces are provided to allow individual student work</li> <li>• Spaces encourage and allow student voice to be heard, students to take responsibility for their own learning</li> <li>• Zones for independent and reflective work</li> </ul>

PHILIPPA SOCCIO

## **14. A NEW POST OCCUPANCY EVALUATION TOOL FOR ASSESSING THE INDOOR ENVIRONMENT QUALITY OF LEARNING ENVIRONMENTS**

### INTRODUCTION

The *EduTool:IEQ* is an evaluation tool that provides succinct and targeted information about the indoor environment quality (IEQ) of learning environments. It is suitable for the multidisciplinary groups involved in commissioning, designing, constructing, operating, maintaining and occupying school facilities. IEQ is an environmental issue concerned with the levels of lighting, thermal comfort, air quality and acoustics inside a space. In a school context, IEQ performance is important, as poor IEQ can trigger health and learning difficulties for students and adversely impact on the wellbeing of educators and their students.

The *EduTool:IEQ* assesses and quantifies the performance of 16 IEQ components identified in the literature as having the greatest potential to impact on effective teaching and learning. The assessment involves collecting objective data about each, using environmental monitoring equipment. The findings of the evaluation are communicated using the *EduTool:IEQ* info-graphic, which is a data visualisation method. The *EduTool:IEQ* info-graphic is unique because it enables its users to immediately identify how the 16 IEQ components perform relative to recommended levels of industry practice. Giving stakeholder groups access to this type of information can enable targeted and cost-effective remedial works that benefit students and educators to be identified and undertaken inside the learning environments. The findings also provide a valuable source of feedback loops for built environment professionals seeking information about opportunities to improve their future practice.

### CONTEXT – THE IMPACT OF IEQ ON STUDENT WELLBEING

This chapter outlines the development of a new post occupancy evaluation (POE) tool used to assess the indoor environment quality (IEQ) inside learning environments. POE “is the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time” (Preiser, 2001, p. 9). POE tools are used by evaluators to control and document the inputs and parameters that are assessed as part of the evaluation process (Baker, 2011).

Learning environments are complex learning spaces overlaid with environmental, pedagogical, socio-cultural, curricular, motivational, and socio-economic issues (Figure 1) (Higgins, Hall, Wall, Woolner & McCaughey, 2005). IEQ is an environmental issue concerned with the levels of lighting, thermal comfort, air quality and acoustics inside a space. Poor IEQ performance inside a learning environment can trigger health and learning difficulties for students (Daisy, Angell & Apte, 2003; Earthman, 2004; Coalition for Healthier Schools, 2013). Young students attending primary and middle schools are particularly vulnerable because of the dynamic state of growth their bodies and minds are undergoing (World Health Organisation, 2006). The risk of environmental exposure is exacerbated inside learning environments because of the amount of time that students spend at school. It is estimated that a student will spend 15,000 compulsory hours in the physical school environment during their formative years and 85% to 90% of this time indoors (Johnson & Kristonis, 2010; Rutter, 1979; USEPA, 2008).

The IEQ performance inside a building may be impacted by how the building has been designed, constructed, maintained and/or operated by the occupants (Vittori, 2002). In this chapter a building with good IEQ performance is defined as one that:

does not cause or aggravate illnesses in the building occupants, assures a high level of comfort to the building's occupants in the performance of the designated activities for which the building has been intended and designed. (Bluyssen & Loomans, 2003, p. 21)

Appropriately designed school facilities form an important part of promoting effective teaching and learning. A fundamental requirement in the design of educational facilities is to provide an environment that facilitates educational effectiveness and student development without adverse health effects (Ali, Almomani & Hindeih, 2009). The OECD (2013) defines educational effectiveness as “the ability of a school or school system to adequately accomplish its stated educational objectives” (p. 4). Student development is defined as “the way that a student grows, progresses or increases his or her developmental capabilities” (Rodgers, 1990, p. 4). Adverse health effects are defined as “the causation, promotion, facilitation and/or exacerbation of a structural and/or functional abnormality” (Sherwin, 1983, p. 177).

Educational success can be directly impacted upon by student absenteeism from school and impaired performance whilst at school. In *Equity and Quality in Education* the OECD (2012) highlights that educational failure can impose a high cost on both the individual and society. The OECD describes the likelihood of fewer life prospects for students who miss out on developing the knowledge and skills that come with gaining a formal education.

In developed countries, asthma is the leading cause of school absenteeism. Research has identified the condition of the learning environment to be a probable asthma trigger (AIHW, 2011; Belanger, Kielb & Lin, 2006; Simons, Hwang, Fitzgerald, Kielb & Lin, 2010). In the US there are over seven million students with asthma (CDC, 2012). In Australia it is estimated that one in nine school-aged



EVALUATION TOOL FOR ASSESSING THE INDOOR ENVIRONMENT QUALITY

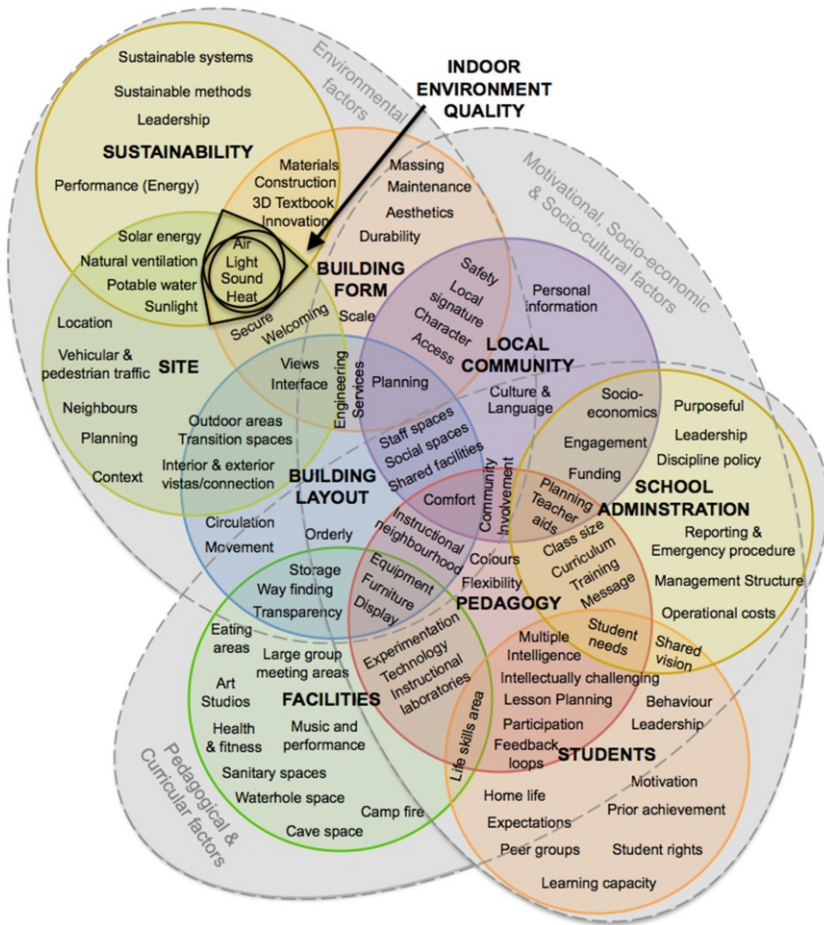


Figure 1. Indoor environment quality positioned amongst the environmental, motivational, socio-economic, socio-cultural, pedagogical and curricular factors that can impact on effective teaching and learning

children has asthma (AFA, 2009; AIHW, 2011). A student with asthma may be absent from school during the period directly after an attack. They may also be absent on days when there are an increased number of triggers present (CDC, 2012). The number of days that a student is absent from school due to asthma can be reduced through appropriate asthma management programs (Grant & Brito, 2010; Meng, Babey & Wolstein, 2012). Through assessing the air quality inside the learning environment, the evaluation tool can be used to determine the probable causes of asthma triggers and aid in the development of appropriate asthma management programs, to mitigate the risks.



Figure 2. The effects of poor IEQ inside the learning environment on student well-being

Impaired performance relates to students' inability to concentrate, process and retain information about the activities that they are working on in their learning environment (Figure 2). In the United States, Kats (2006) identified "some 55 million students spend[ing] their days in schools that are too often unhealthy and that restrict their ability to learn" (p. 2). In *Towards Healthy Schools 2015* (Coalition for Healthier Schools, 2013) the authors argue that the "physical environmental stressors in schools measurably and significantly affect children's achievement" (p. 6).

OBJECTIVE – A NEW IEQ EVALUATION TOOL TO SUPPORT THE EVIDENCE  
BASED DESIGN OF SCHOOLS

The purpose behind creating the new POE tool was to provide a multidisciplinary audience comprising stakeholders involved in commissioning, designing, constructing, operating, maintaining and occupying school facilities, with succinct and targeted information about the IEQ performance inside school learning environments. In developing the new POE tool, the writer aimed to fulfil the design criteria set out by a review of existing POE tools. The review included 24 POE tools used for assessing educational facilities and 19 POE tools used for assessing IEQ performance inside buildings.

The identified criteria required a new POE tool for assessing IEQ performance of learning environments to:

1. Build on the measurement parameters used by the Mobile Architecture and Built Environment Laboratory (MABEL) developed at Deakin University (Luther & Schwede, 2006). The MABEL system was originally developed to “provide internal environment performance for commercial, industrial and residential buildings” – not educational facilities (Luther & Schwede, 2006). After trialling MABEL inside a school, Luther (2012) observed that, “in hindsight and in reference to the recent literature and experience from our case studies, the measurement sub-systems [of MABEL] could be dramatically improved” (p. 2). Luther highlighted the importance of evaluating the IEQ performance of educational facilities by collecting data about the IEQ components that were influential on effective teaching and learning.
2. Collect data about the conditions external to the learning environment. Luther (2012) observed that MABEL did not do this, and it was “quite obvious that external weather and solar conditions were the drivers of indoor comfort and energy consumption” (p. 4). He also cited the impact that operable windows could have specifically on air quality and acoustics.
3. Consider how the results would be presented to a wide group of stakeholders. Luther (2012) observed that MABEL “lack[ed] effective presentation and analysis of the results” (p. 7). He argued that addressing this would be “a significant and onerous task, yet, one which is required if scientific results are to influence decision-makers on school budgets” (p. 7).
4. Develop and apply to performance an overall IEQ Index to quantify results, one that allows for the performance of multiple IEQ components to be assessed together. Luther (2012) commented that he was “suspicious of studies where an assessment of a singular sub-system is observed in regards to improved performance or absenteeism” (p. 6).
5. Investigate the relationship between design decisions and outcomes. The need for this was highlighted by Candido, de Dear, Thomas, Kim & Parkinson (2013, p. 1). They cited research by Newsham et al., and Cooper who attributed the cause of the disconnect to “experimental green technologies that were not well understood and did not perform as expected by the designers who specified them” (p. 42) and a knowledge transfer barrier between the design team and the end-users.
6. Collect objective data about actual building performance. The need for this was highlighted in the *Business Case for Green Star Performance* (GBCA, 2013). This document forecast that the Green Star Performance tool could have the same impact in Australia as the LEED EBOM tool had in the US. For example, the “LEED EBOM tool drove more certifications in one year than all the other LEED tools have done in their history” (GBCA, 2013, p. 5).
7. Focus on holistic and whole-building approaches to design. This point was raised in a critique by the Environment and Human Health Inc. (EHHI) of the LEED rating tool. EHHI (2010) found that the “scoring system is weighted too heavily towards energy conservation and the use of new and renewable technologies” (p. 7). Citing the EHHI report, the Institute of Medicine (IOM)

(2011) expressed concern that the bias of green building rating tools may result in ‘sustainable buildings’ that were neither healthy, nor productive workplaces. The criticism of green building rating tools such as LEED, BREEAM and Green Star was directed at how points are awarded.

8. Have a clearly defined design intention (Adeyeye, Piroozfar, Rosenkind, Winstanley & Pegg, 2013).
9. Be transparent about its processes (Adeyeye et al., 2013).
10. Be developed to “ensure that the knowledge gained from the research studies is not only disseminated in the academic community but also successfully transferred to the world of designers, builders and financiers of real estate” (Vischer, 2002, p. 29).

#### METHODOLOGY & METHODS – ROLE OF THE RESEARCHER AND CONSTRAINTS

The new evaluation tool was developed as one of the outcomes of the writer’s PhD in Architecture at the University of Melbourne (Soccio, 2014). It aimed to answer the research question: *How can indoor environment quality data be collected and analysed to communicate to a multidisciplinary audience, succinct and targeted information about the quality of the environment inside primary and middle school classrooms?* The study’s aim was to find a way of aiding built environment professionals to apply a whole-building approach to designing IEQ inside the learning environment. The assertion that built environment professionals need to ‘broaden’ their understanding of IEQ came from opinions expressed in the literature, specifically about the need to improve how IEQ education is taught in tertiary institutions. For example:

- The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE, 2010) in its *Research Strategic Plan 2010–2015* set the goal to “significantly increase the understanding of energy efficiency, environmental quality and the design of buildings in engineering and architectural education” (p. 21),
- The School of Architecture at the Carnegie Mellon University (Pennsylvania, USA). Loftness, Lam and Hartkopf (2005) argued for the need for “curricular change in architecture and engineering departments to embrace more fully systems integration for building performance” (p. 196); and
- The Faculty of Architecture at Delft University of Technology (Netherlands). Here Bluysen (2013) proposed a new program to the faculty that would have issues of IEQ and design, more holistically integrated into the curriculum.

The development of the new POE tool was approached by using a critical pragmatist epistemology and in-depth ontology (Froeyman, 2012). This led to the pursuit of pragmatic methods, but also critical thinking about the relationship between the method and the outcome (White, 2004; Joas, 1996). Depth ontology

was used to seek out the hidden conditions that influence the learning environment operators' day-to-day experience of IEQ (Greener, 2011; Merker, 2010). This informed a decision to approach the research as a rationalist and not as an empiricist.

Rationalists believe that knowledge is gained independently of sense experience, while Empiricists believe that sense experience is the ultimate source knowledge (Plotkin, 2008). Students and educators experience IEQ inside the learning environment as empiricists. Their perception of 'quality' can be biased by the human sensory system (Kim, Paulos & Mankoff, 2013). Human sensors have limited capacity to experience and differentiate between IEQ components and their varying levels of performance (IPMVP, 2002). Consequently, a subjective evaluation may only capture the occupants' understanding of "what is observable" (Castree, 2005, p. 214) or of concern to them at a specific point in time (IPMVP, 2002). This finding is consistent with that of Kim and de Dear (2012) in a study of how occupant perception of specific IEQ factors affected overall satisfaction. They found that inside office environments, when IEQ factors are performing well "they tend to go unnoticed" (p. 6). However, when the performance of the IEQ factors was perceived to be inadequate and failed to meet occupant expectations it prompted significant overall dissatisfaction.

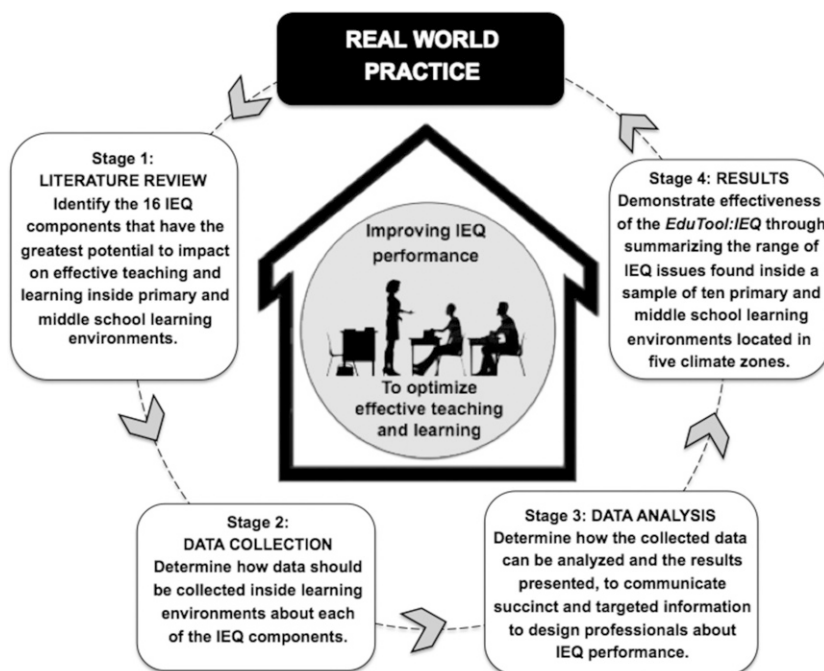


Figure 3. Design of the writer's study outlining the four research stages that centred around the aim to improve IEQ performance inside primary and middle school learning environments to optimise effective teaching and learning



The new POE tool was developed using an explanatory sequential design framework. This is an approach that starts with a research method or question and uses the findings to inform the subsequent stages of the research (Creswell & Plano Clark, 2011). The methodology had four distinct stages (Figure 3). Each stage was informed by a subsidiary research question and had practical outcomes that were centred on real world practice and the need to improve the IEQ performance inside primary and middle school learning environments to optimise the opportunities for effective teaching and learning. To aid in the development of the subsidiary research questions, the researcher consulted the Higher Education Design Quality Forum's (HEFCE, 2006) *Guide to Post Occupancy Evaluation*. The subsidiary questions asked in the study were:

- What are the IEQ components found inside primary and middle school learning environments that have the greatest potential to impact on effective teaching and learning?
- How is data about IEQ collected inside primary and middle school learning environments?
- How can IEQ data be analysed and the results communicated to enable a multi-disciplinary audience to describe the overall IEQ performance inside primary and middle school learning environments as well as identify for stakeholders the probable cause of specific IEQ issues?
- What is the IEQ performance inside a sample of existing primary and middle school learning environments, located across five Australian climate zones?

#### RESULTS – LINKING IEQ TO HEALTH AND WELLBEING

The new POE tool used for assessing the IEQ performance inside primary to secondary school learning environments is called the *EduTool:IEQ*. It assesses the performance of the 16 IEQ components that were identified in a literature review as having the greatest potential to impact on effective teaching and learning.

There are four stages involved in using the *EduTool:IEQ*. The *first stage* is data collection. The tool prescribes the methods that an assessor should use to collect objective, descriptive and subjective data about the 16 IEQ. Objective data is collected using environmental monitoring equipment. Descriptive data is collected using overt observation about the physical conditions inside the learning environment along with observations about how the occupants' behaviour may have influenced the objective data collected. Subjective data is collected through stakeholder engagement such as focus group activities and questionnaires.

The initial literature review identified the presence of over 40 IEQ components that could impact on the quality of the indoor environment of a learning environment. Using causality theory (and causal chaining) this group of components was reduced to 16, with groupings of four components chosen for acoustics, lighting, air quality and thermal comfort (Mendell & Heath, 2005; Soccio, 2014). There is no hierarchy

amongst these components. This decision was influenced by arguments made in the literature about the need for built environment professionals to conduct their practice with a whole building approach that “takes full advantage of the symbiotic nature of design so that the design elements work to reinforce each other and thereby maximise the ability of the overall building design to fulfil its design objectives effectively and with greater efficiency and also lower capital and operating costs” (ASHRAE, 2009, p. 162).

In the *second stage*, the data collected about the 16 IEQ components is processed. However, only the objective data is used. Processing the data involves calculating a single quantitative result (QR) for each of the 16 components. In order to do this, it is first necessary to define the ‘period of occupancy’ under investigation. The QR is a calculation that takes the average of all the data points collected for the component during the period of occupancy. Inside the ten learning environments evaluated in this study using the *EduTool:IEQ* the period of occupancy was: ‘school hours’ (7:30am to 4:29pm) on weekdays during term time. The period of occupancy allowed for activities conducted inside the learning environment during, before and after the formal school day. For each component, two QRs were calculated. One was indicative of performance in winter and the other was indicative of the performance in summer. Having two QRs allowed for comparisons to be made.

In the *third stage*, the QRs calculated for each component were analysed to determine (in qualitative terms) their level of performance. To do this the assessor used the *EduTool:IEQ Evaluation Indices* – a type of environmental index that quantifies and numerically benchmarks the QR against different levels of industry

Table 1. Example of the *EduTool:IEQ* Evaluation Indices for carbon dioxide

Score	Performance thresholds	Score	Carbon dioxide levels (ppm)
10	Achieves next practice	10	400*–600
9	Achieves best practice	9	601–700
8	Achieves excellent practice	8	701–800
7	Achieves good practice	7	801–900
6	Achieves acceptable practice	6	901–1000
5	Achieves minimum practice	5	1001–1100
4	Below minimum practice	4	1101–1200
3	Unsatisfactory practice	3	1201–1300
2	Problematic practice	2	1302–1400
1	Unacceptable practice	1	1401 +
0	No data set	0	No data

\*Carbon dioxide concentrations cannot go below outside levels



practice (Table 1). The indices were a culmination of the performance-based advice published about IEQ in over 70 sources. A QR score of 10/10 as an example of ‘next practice’, i.e. a level of performance that went beyond current best practice). A QR score of 1/10 was an example of ‘unacceptable practice’. A QR score of 5/10 achieved the minimum required level of practice. (The *EduTool:IEQ Evaluation Indices* would need to be periodically updated to remain current.)

In the *fourth stage*, the results of the evaluation were succinctly communicated using the *EduTool:IEQ Info-graphic* – a data visualisation method. Built environment professionals are often more attracted to information that is communicated graphically, rather than textually or numerically. Therefore presenting technical information using data visualisation was believed to complement the natural tendencies of built environment professionals. In the theory on info-graphics, the shapes that are generated using numbers could have a greater impact on their audience compared with numbers alone (Sullivan, Case, Bolz, Mijksenaar, Ward, & Burkhardt, 1996, p. 62). The *EduTool:IEQ Info-graphic* could succinctly communicate information about the IEQ performance inside a learning environment across the macro, mezzo

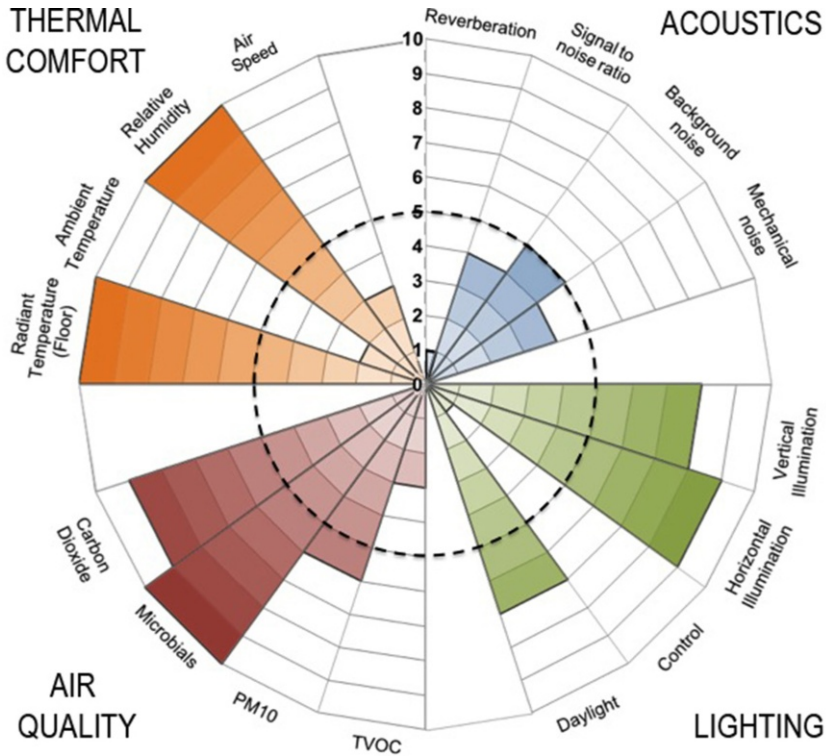


Figure 4. The EduTool:IEQ Info-graphic

and micro scales. Each scale represented a unique level of analysis that targeted the specific information about the IEQ performance inside a learning environment that might be required by different built environment professionals. At the macro scale, the uniformity and total number of shaded cells in the *EduTool:IEQ Infographic* might be used to explain the overall IEQ performance inside the learning environment. At the mezzo level, the performance of the four IEQ sub-systems might be compared. At the micro level, it is possible to investigate the performance of individual IEQ components.

#### IMPLICATIONS FOR TEACHERS AND DESIGNERS – USING EVIDENCE TO SHAPE DESIGN

The EduTool:IEQ was developed to provide succinct and targeted information about the IEQ performance inside primary and middle school learning environments. The stakeholder groups that could benefit from receiving this information included *learning environment operators* (students, and educators), *school administrators* (facility managers and maintenance staff), and *built environment professionals* (school facility planners, architects, interior designers, industrial designers, engineers and builders).

Poor IEQ can reduce the effectiveness of good pedagogy as students occupying the space may struggle to see, to hear and understand instruction or to concentrate (Faustman, Silbernagel, Fenske, Burbacher, & Ponce, 2000; Fisk, 2000; Heschong Mahone Group, 1999; Kats, 2006; Mendell et al., 2002; Mendell et al., 2005; Wakefield, 2002). As stated earlier learning environments with poor IEQ can exacerbate the effects of respiratory illness amongst susceptible children, causing them to be absent from school. Standardised test scores confirm students who are regularly absent from school achieve lower grades, compared with regular attendees (Balfanz & Byrnes, 2012; Kohen, 2010; Moonie, Sterling, Figgs, & Castro, 2008).

#### CONCLUSION – IMPACT AND FUTURE DIRECTIONS

Learning environments are the workplace of educators. A large body of research has been published about the relationship between employee productivity and the IEQ performance of workplaces (Fisk, 2011; Fisk & Seppanen, 2007). While much of this research has focused on the productivity gains made by professionals working inside office buildings with good IEQ, this chapter argues that good IEQ would also assist the productivity gains of educators working inside learning environments. It would also reduce the costs associated with replacing, recruiting and training new teachers in schools, due to teacher turnover.

A 2010 report by the National Commission on Teaching and America's Future stated that "Green schools increase teacher retention" and teachers cite indoor air quality, access to daylight and views and better acoustics as reasons they prefer high-performing schools (Carroll, Fulton, & Doerr, 2010). Lucas (as cited

in Schneider, 2002) found that educator efficiency is lowered inside learning environments with excessive levels of noise. Poor acoustics inside the learning environment can also be a cause of stress and voice fatigue amongst educators (Frumkin, Geller, & Nodvin, 2007).

For school administrators the benefits of the *EduTool:IEQ* are both inside and outside the learning environment. Owners and operators of school facilities are often in pursuit of new knowledge that will improve the quality of the facilities provided to students and educators (Newton, 2009). Inside the learning environment school administrators may be concerned with how IEQ issues are impacting on effective teaching and learning. Outside the learning environment, school administrators may be concerned with issues of efficiency, related to issues of school operation and management. There are examples in the literature that highlight how IEQ issues inside learning environments can result in higher operational costs due to increased demands placed on energy requirements (Apte et al., 2002; Catalina & Iorcache, 2012; Dascalaki & Sermpetzoglou, 2011). Through using the new POE tool, school administrators can access succinct and targeted information about the IEQ of their learning environments. Such detailed information could enable school administrators to budget for the required remedial works.

The greatest benefit to the built environment professionals is outside the learning environments, through the feedback loops provided by the new POE tool that can be used to inform their future practice (Baker, 2011). By streamlining the process surrounding the collection and analysis of objective data collected inside learning environments, the new POE tool aims to remove the perception amongst built environment professionals that conducting POEs is difficult (Preiser, 2002). The new POE tool communicates the results of an evaluation using an info-graphic – a data visualisation method. Examples in the literature highlight the fact that built environment professionals are often more attracted to information that is communicated graphically rather than textually (Lawson, 2006). Built environment professionals can apply deductive reasoning to the succinct and targeted information provided by the new POE tool to identify the cause of specific of IEQ issues (Holyoak & Morrison, 2005). The findings can empower built environment professionals to work with learning environment operators and school administrators, to devise a plan of action about the required remedial works (which may require physical or behavioural changes).

This chapter described the IEQ performance inside learning environments as a trigger for health and learning difficulties for students. Built environment professionals and school administrators can have a hand in improving the IEQ performance inside learning environments through making well-informed decisions based on the feedback loops provided by POE tools. The *EduTool:IEQ* is a new POE tool that communicates succinct information to multi-disciplinary audiences about the IEQ inside learning environments. The information is ‘succinct’ because it communicates the findings across three scales. To date the *EduTool:IEQ* has been

used in ten evaluations. These evaluations have successfully drawn significant attention to the range of IEQ issues impacting on the health and wellbeing of school staff and students.

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## **15. THE EFFECTIVE TEACHING AND LEARNING SPATIAL FRAMEWORK**

*An Evaluation Tool*

### CONTEXT

The Effective Teaching and Learning Spatial Framework was developed within the context of higher education as part of the writer's PhD research. It was underpinned by an evaluation of four new generation learning environments conducted at four Australian universities. The Framework and resultant evaluation tool is considered to have broader cross sector application into Schools, TAFE institutions and corporate learning environments.

The objective of the PhD was to develop an evaluation tool that: could be applied to any formal classroom space to test its alignment with effective teaching and learning practice; could be implemented by teachers to help develop their teaching practice; could be implemented by designers to help design activity-based classrooms; was simple to use (anyone can implement), and could be repeated any time.

### INTRODUCTION

Within the last fifteen years a new space typology has emerged on University campuses across the world, vicariously called New Generation Learning Environments or Spaces, and presenting an alternative to traditional classrooms such as lecture theatres, tutorial rooms and seminar spaces. These new classrooms have developed out of academic demand for spaces that enable greater collaboration and interaction between students, underpinned by an understanding of 'good' or 'effective' teaching and learning processes.

### METHODOLOGY & METHODS

A literature review of 'student-centred learning' conducted for the PhD revealed a distinct theoretical and practical domain referred to as 'effective teaching and learning'. The term refers to an approach to teaching and learning that is holistically dedicated to enabling students to foster a deep approach to learning. In dissecting the 'effective teaching and learning' literature, key concepts have surfaced and resulted

in profound implications for student learning behaviour and consequently the revelation of key spatial characteristics that will foster desired learning behaviours. Six essential elements of effective teaching and learning have been distilled from the literature, as outlined in [Table 1](#), and are discussed below.

*Table 1. Essential elements of effective teaching and learning*

<i>Effective teaching and learning</i>	<i>Literature references</i>
1. ...promotes student activity and engagement with content; empowers students with choices and maintains interest through a variety of activities, resources and learning styles.	(Biggs & Tang, 2007; Entwistle, 2009; Hounsell, 1997; Prosser & Trigwell, 1999; Ramsden, 2003, p. 93; Shuell, 1986; Skinner, 2010)
2. ...encourages the teacher to view teaching from the student's perspective and build meaningful relationship with students	(Entwistle, 2009; Laurillard, 2002; Marton & Booth, 1997; Prosser & Trigwell, 1999; Ramsden, 2003; Rogers, 1969)
3. ...is a social process whereby knowledge is socially constructed	(Dewey, 1897; Dewey, 1961; Garrison & Archer, 2000; Laurillard, 2002; Lave & Wenger, 1991; Piaget & Inhelder, 1969; Vygotsky, 1978)
4. ...fosters a deep approach to learning that encourages student independence	(Dewey, 1961; Hounsell, 1997; Marton & Saljo, 1997; Rogers, 1969)
5. ...is contextualized & relevant; teachers have an awareness of student prior learning	(Biggs & Tang, 2007; Entwistle, 2009; Hounsell 1997; Kolb & Kolb, 2005; Laurillard, 2002; Prosser & Trigwell, 1999; Ramsden, 2003; Rogers, 1969; Shuell, 1986; Skinner, 2010)
6. ...involves teachers continually evaluating how students perceive their learning situation, the learning approaches being adopted, as well as providing regular and targeted feedback to students, including formal assessment	(Biggs & Tang, 2007; Chickering & Gamson, 1987; Entwistle, 2009; Hounsell, 1997; Laurillard, 2002; Prosser & Trigwell, 1999; Ramsden, 2003)

## EFFECTIVE TEACHING & LEARNING BEHAVIOURS

The effective teaching and learning discourse presents explicit and implicit clues as to the teaching and learning processes that may occur in the classroom. It prompts the question: what does effective teaching and learning in the classroom look like? This section outlines the 'essential elements' to reveal actions and behaviours by teachers and students that contribute to effective teaching and learning. These behaviours are presented as holistic actions rather than fine-grain behaviours. In other words, rather than anticipating the minutia of behavioural possibilities, the schema will rationalise

broad behaviours such as students being able to interact with each other, being able to move around the room and being able to capture digital content.

*1. Effective Teaching and Learning Promotes Student Activity and Engagement*

Students can engage with the learning content in a variety of ways that may involve working individually or in small groups, for example, working from textbooks or work sheets or via educational technologies. Activities to be encouraged and enabled include: creating, producing, brainstorming, researching, analysing, debating, performing, building, and simulating. These activities often require students to move around the room, access technologies and writeable surfaces, work individually but then come together as part of a group, share content with colleagues, or present to the whole cohort. There are spatial consequences for undertaking all these activities. Sometimes these activities will be implemented synchronously, with everyone working to the same activity at the same time. However, it should also be possible for students to choose how they engage with the content to be learned, and there may be multiple student groups working on different activities at the same time.

*2. Effective Teaching and Learning Encourages the Teacher to View Teaching from the Student's Perspective*

Viewing teaching from the student's perspective will involve being able to interact directly with students either as individuals, in small groups, or as a whole cohort. Therefore it is important that the teacher can move around the room easily and is able to access all students equally and equitably. Sharing the resources in the room is another way of fostering an equitable relationship between teacher and students. If the teacher is the only permitted user of the technologies in the classroom, then the teacher will remain disconnected from the student's perspective. In order to promote shared and equitable access by both teachers and students classroom resources should be positioned around the room.

*3. Effective Teaching and Learning is a Social Process Whereby Knowledge is Socially Constructed*

Engagement in the learning process often begins with, or is enhanced by, students connecting with each other on a social level. As they get to know each other, social conversations comfortably transform into learning conversations. Social connections often break down cultural, emotional and academic barriers, paving the way for greater engagement around learning content. Social behaviours are impacted by the distance between people, so the classroom should enable students to interact at 'personal', 'social' and even 'intimate' distances, as defined by Hall (1970). Students may need to engage in different ways at varying distances but simultaneously in the classroom.

*4. Effective Teaching and Learning Fosters a Deep Approach to Learning that Encourages Student Independence*

Empowering students with choice as to how they engage with learning will foster independence. It may be as simple as students being able to choose a learning activity or assessment method, or it may involve allowing students to manipulate the physical environment. Students may choose the speed at which they complete assessment milestones. This may mean that they are working on different tasks at the same time, accessing different resources at the same time, and seeking guidance on different aspects of the curriculum. Therefore the classroom will need to be agile enough to cope with a variety of parallel student activities and interactions that are fostering movement and creating noise throughout the environment.

*5. Effective Teaching and Learning is Contextualised and Relevant; Teachers have an Awareness of Prior Learning*

Every student brings a unique context and prior learning experience that influences the product of interactions among the cohort. Relevant learning content is of fundamental importance to students and contributes significantly to their motivation to engage. An effective teacher will harness the differences that exist in every cohort by understanding prior learning and what is relevant to all students. Giving students and teachers the opportunity to connect and build this level of understanding may involve a combination of enabling a social learning environment, fostering independence and promoting various individual and collaborative activities. Highly engaged students who are motivated to learn should be able to use the classroom environment in a variety of ways that suit each unique situation, hence the criticality of providing an agile physical classroom environment.

*6. Effective Teaching and Learning Involves the Teacher Providing Effective and Timely Feedback*

One of the most valuable contributions to student learning is effective and timely feedback. This may happen in many different ways such as digitally, via assessment, or verbally in the classroom. This reinforces the importance of the teacher being able to equitably access and communicate with all students in the classroom. However, when group work is being undertaken the teacher may prefer to evaluate group progress from afar, by being able to see brainstorming notes on a wall, refer to a digital screen, or hear discussions taking place. Rather than hovering around student groups, which may interrupt their thought process, teachers can effectively maintain an awareness of progress from afar. This also diminishes the student's reliance on the teacher and thus fosters independence. As soon as a student or group appears to be having difficulty of falling behind, the teacher can offer assistance. Therefore, being able to connect visually with all students in every corner of the room and to

the content with which they are engaging, is vital in the classroom. Teachers need to be able to scan a group from afar or be able to interact at close distance.

#### THE EFFECTIVE TEACHING AND LEARNING SPATIAL FRAMEWORK

A critical finding of the research undertaken by the writer was the compelling relationship between effective teaching and learning (as described in the literature), effective teaching and learning behaviour (as inferred in the literature) and critical spatial qualities associated with new generation learning environments. As discovered throughout observations of various classrooms, qualities of space could include tangible objects such as furniture and technologies, but also non-tangible elements such as spaciousness, a variety of furniture and access to classroom resources.

The spatial elements mentioned above have been synthesised below into six essential spatial qualities that are considered critical to the design of new generation learning environments in order to enable effective teaching and learning to occur. They are:

1. Spaciousness
2. Mobility of furniture
3. A variety of furniture settings
4. Accessible educational technologies for students
5. Active surfaces, and
6. Student access to all classroom features.

These qualities do not ignore indoor environmental qualities (IEQ) that are known to affect the experience of learning, such as natural light, thermal comfort and fresh air (Lackney, 1999; Nair & Fielding, 2005; Tanner & Lackney, 2006). The six essential spatial qualities listed above are a unique contribution from this study to existing learning space discourse and are considered complimentary to accepted IEQ conditions.

##### *1. Spaciousness*

Spaciousness is a spatial quality often associated with having ample room to move, although it has greater implications for bestowing a sense of freedom for the occupants of space. While Tuan (1977) declared that “a setting is spacious if it allows one to move freely”, he also asserted that “spaciousness is closely associated with the sense of being free. Freedom implies space; it means having the power and enough room in which to act” (p. 52). Space is objective and tangible – it has a volume that is measurable. The elements within a space and the number of occupants within will contribute to its sense of ‘spaciousness’. A 60m<sup>2</sup> space with a 3 metre high ceiling and minimal furniture will feel spacious to a single occupant, however the same space with sixty occupants will most likely feel crowded. Depending on the number of occupants, the ceiling height and other elements within the space

(e.g. furniture), the point at which the room begins or ceases to feel spacious is subjective and difficult to define.

In the context of new generation learning environments, having ample space to move around is fundamental, not only for enabling the teacher to move easily around the room to engage with students, but to enable students to move freely around the room, engaging with other students and participating in a variety of learning activities. However, as per Tuan's interpretation (1977), spaciousness in a classroom environment should engender a sense of freedom in students to initiate activities, access resources, or engage with others, relevant to their learning objectives. An 'effective' teacher provides some structure and guidance, but liberates students to take ownership of their learning experience. An 'effective' learner should be empowered to access resources and people within and beyond the classroom. Effective teaching requires the teacher to access all students equally and directly engage with them in order to better understand their perspective. Spaciousness generates possibilities for students to engage with each other either through planned activity or through spontaneous, serendipitous opportunity.

Spaciousness therefore enables freedom, creativity, spontaneity and serendipity within the learning situation. Students and teachers can move unencumbered around the room to benefit interaction and communication. It enables floor space to be used in creative ways, from students sitting (or lying) on the floor or developing a performance, to spreading material out, or to facilitating the use of instruments. Spaciousness is a valuable educational commodity that has been identified as a critical spatial feature of new generation learning environments.

## *2. Mobility of Furniture*

Mobility is the ability for a piece of furniture to be easily moved without undue effort. This includes chairs and tables on castors, or lightweight furniture that can be easily relocated or reconfigured. Historically furniture in most learning settings has been either fixed or heavily constructed to avoid mobility. Typical educational settings have been established to focus on the teacher, inhibiting reconfiguration of furniture that may place greater emphasis on student activity and initiatives. Immobile furniture signal to students that they are to remain fixed and focused on the teacher, thus reducing any sense of learning initiative.

Mobile furniture provokes the development of student learning initiatives beyond the norms of classroom inertia associated with lectures and tutorials. Developing student independence, as a recognised objective of effective teaching and learning, is partly orchestrated by empowering students to take ownership of their environment. If a student is compelled to manipulate the physical environment in order to enable specific learning activities, then that student is demonstrating initiative. Effective teaching will encourage such initiative within the physical limitations of the classroom.

Power and hardwired data supply to computers and other equipment naturally prevents mobility of some furniture, particularly tables. This is one of the most difficult spatial elements to contend with in the design of new generation learning environments, as it can become a significant constraint for where and how learning activities are enacted.

The mobility of chairs, coupled with spaciousness, enables students to develop initiative by manipulating the physical environment to support the learning activities that are relevant and immediate to their needs.

### *3. Variety of Furniture Settings*

A variety of furniture settings enables different activities to simultaneously take place. In the context of effective teaching and learning this establishes choices for students, further developing their learning initiative. Teachers may assign learning objectives and guidelines but enable students, with consultation, to plan and implement multiple activities to achieve those objectives. Enabling a variety of activities presupposes that students can work at their own pace, influenced by their prior learning experience and perspective of their learning situation. Therefore, providing a variety of furniture settings that enables concurrent learning activities will support many of the characteristics of effective teaching and learning.

Having a variety of settings is in distinct contrast to furniture settings within traditional classrooms, lecture theatres and tutorial rooms. Lecture theatres traditionally contained one type of fixed seat facing the teacher, with a tablet for writing on. Tutorial rooms typically have modular furniture, which whilst potentially mobile, is conventionally set out in rows all facing the teacher. Even when student activities are implemented, the experience would generally involve all students undertaking the same activity.

A variety of furniture will support a variety of activities, but a variety of activities can also be supported by settings that are purposefully designed with an understanding of the spectrum of possible activities. Enabling a variety of activities is a critical characteristic of new generation learning environments.

### *4. Accessible Educational Technologies for Students*

The new generation learning environments evaluated in the writer's research all enabled internet access to students with computers provided at a ratio of one computer per three students, or lower. This access negated the computer laboratory effect of one person per computer that may tempt students to be distracted by social media and other personal interests. A lower ratio of computers promotes collegiality and cooperation among students, increasing the likelihood that computers in the classroom will be utilised in a manner that is relevant and symptomatic of effective teaching and learning.



In contrast to standard classrooms on campus, where educational technologies are the domain of the teacher, new generation learning environments are distinguished by the emphasis placed on enabling student access to the educational technologies within the classroom. Furthermore, students increasingly carry internet-enabled devices to class such as laptops, smartphones and iPads, increasing the necessity for classroom access reliable and fast Wi-Fi systems. Students can use their devices to enhance the learning experience and promote collaboration by capturing content, accessing web-based resources or sharing material with peers.

Universities' investment in sophisticated intranet services has created hybrid learning environments where students can access unimaginable quantities of information wherever they have access to the internet. As internet-enabled computer resources are a key characteristic of new generation learning environments, students can access a world of knowledge relevant to the context of their learning encounter.

The presence of computers in new generation learning environments begins to normalise the experience of accessing internet resources at any time. In this sense, effective teaching and learning is enhanced through the choices and possibilities presented to teachers and students by accessing internet-based resources in real time, reacting to spontaneous demand and relational to relevant learning activities.

### *5. Active Surfaces*

New generation learning environments are about promoting effective teaching and learning, where according to Shuell, "what the student does is actually more important in determining what is learned than what the teacher does" (1986, p. 429). A key aspect of this is being able to express oneself and to share and communicate cognitive activity with others in the room.

Students build confidence in their learning when they can see or hear what other students are doing. Whether a student is working individually or in a small group, it is reassuring for students to know that they are on the right track. Inspiration and motivation can occur when students can see other students productively engaging, and crucially, see the product of that engagement. A classroom environment can facilitate this with 'active surfaces', that is, walls and floors that can be used for different learning activities. Examples of active walls include whiteboards, pin-boards, blank walls for projection and wall-mounted LCD or plasma screens. An active floor may consist of unoccupied floor space, either permanently vacant or created by moving furniture out of the way, where an array of alternative activities may take place.

Students' monitoring other students in the room, and teachers easily monitoring what students are doing, have an underestimated benefit of learning in the classroom. Monitoring is enabled through 'active wall' features where students can develop ideas, plan assignment tasks and demonstrate understanding that is displayed for the teacher and other students to see. Active surfaces are a spatial feature that should

be considered in new generation learning environments, to facilitate experiential learning, knowledge sharing and monitoring among students and teachers.

### *6. Students Access to All Features*

Effective teaching and learning fosters a deep approach to learning through the development of student initiative and independence in the learning process. This implies a more democratic relationship between teacher and student, as distinct from the authoritarian relationship that prevails in many teacher-centred situations. Teachers can nurture a democratic relationship simply by availing use of all aspects of the classroom environment to students, free of rules and encumbrances that convey the teacher's command. New generation learning environments are designed as student-centred spaces, enabling student access to all features of the room or precinct.

It is important to stress that while many teachers in the writer's PhD study said their students were advised they were free to move around the classroom as they wished, it was only activities instigated by the teacher that compelled any movement by students.

## THE EFFECTIVE TEACHING AND LEARNING SPATIAL FRAMEWORK

The Effective Teaching and Learning Spatial Framework (below) integrates the essential elements of effective teaching and learning with their relational behaviours and spatial qualities as seen in [Table 2](#). The convergence of these three tracts begins to form a response to the question: What does effective teaching and learning look like? The physical environment plays a critical role in deliberately enabling the identified teaching and learning behaviours with specific spatial characteristics presenting fundamental opportunities for teachers and students to engage with each other in a variety of meaningful ways.

A deliberately non-deterministic spatial framework has been developed to ensure pedagogical flexibility and design agility. Teachers will have the freedom to implement a vastly increased range of learning activities compared to the opportunities inherent in typical lecture theatres and tutorial rooms. Architects and designers will have the freedom to apply the spatial qualities in ways only limited by their imagination. They can be applied in a generic sense, for use by a wide range of disciplines or tailored to specific contexts such as science laboratories.

## THE EFFECTIVE TEACHING AND LEARNING EVALUATION TOOL

The evaluation of new generation learning environments has emerged as an important bi-product of new classroom typologies as universities seek to demonstrate better student outcomes and to validate significant investment in new generation learning

Table 2. The effective teaching and learning spatial framework

<i>Effective teaching and learning:</i>	<i>Teaching and learning behavior:</i>	<i>Spatial qualities:</i>
1. ...encourages the teacher to view teaching from the student's perspective and build meaningful relationships with students	<ul style="list-style-type: none"> <li>• the teacher moves around the room to access all students equally and equitably;</li> <li>• the teacher and students accesses the same educational technologies;</li> <li>• the teacher is able to engage with students individually, in small groups or as a whole cohort</li> <li>• students feel valued and respected</li> </ul>	<p><i>SPACIOUSNESS</i> to enable easy movement around the room</p> <p><i>ACCESSIBLE EDUCATIONAL TECHNOLOGY</i> for students as well as the teacher</p> <p><i>MOBILE FURNITURE</i> to enable quick and easy reconfiguration of the classroom</p>
2. ...is a social process whereby knowledge is socially constructed	<ul style="list-style-type: none"> <li>• students engage with each other and with the teacher;</li> <li>• students collaborate, interact and communicate with each other in many different ways</li> </ul>	<p><i>VARIETY OF FURNITURE SETTINGS</i> to encourage different types of activities</p> <p><i>ACTIVE SURFACES</i> for sharing ideas and experiences</p>
3. ...fosters a deep approach to learning that encourages student independence	<ul style="list-style-type: none"> <li>• students can focus on learning activities during class;</li> <li>• students consolidate meaning through discussion with teachers and peers</li> <li>• students manipulate the environment to suit their needs;</li> <li>• students move around the room to access appropriate resources;</li> <li>• students may move around the room to communicate with other students</li> </ul>	<p><i>VARIETY OF FURNITURE SETTINGS</i> to suit the varying needs of each class and each student</p> <p><i>MOBILE FURNITURE</i> to enable quick and easy reconfiguration by students</p> <p><i>STUDENT ACCESS TO ALL FEATURES</i> in the room/ precinct: no barriers</p>
4. ...promotes student activity and engagement with content; empowers students with choices and maintains interest through a variety of activities, resources and learning styles	<ul style="list-style-type: none"> <li>• multiple students/groups access relevant technologies and resources simultaneously;</li> <li>• different students undertake different activities simultaneously</li> <li>• students share/record/save ideas and <i>new</i> knowledge for future reference.</li> </ul>	<p><i>ACCESSIBLE EDUCATIONAL TECHNOLOGY</i>, internet-enabled and in multiple numbers</p> <p><i>VARIETY OF FURNITURE SETTINGS</i> to enable different activities</p> <p><i>ACTIVE SURFACES</i> for capturing and sharing ideas</p>

Table 2. (Continued)

<i>Effective teaching and learning:</i>	<i>Teaching and learning behavior:</i>	<i>Spatial qualities:</i>
5. ...is contextualised & relevant; teachers have an awareness of student prior learning	<ul style="list-style-type: none"> <li>• students undertake activities relational to their prior learning experience;</li> <li>• different students work at different paces;</li> <li>• different students undertake different activities simultaneously</li> <li>• students access resources relevant to their needs</li> </ul>	<p><i>VARIETY OF FURNITURE SETTINGS</i> to enable different activities</p> <p><i>ACCESSIBLE EDUCATIONAL TECHNOLOGY</i> for students as well as the teacher</p>
6. ...involves teachers continually evaluating how students perceive their learning situation, the learning approaches being adopted, as well as providing regular and targeted feedback to students, including formal assessment	<ul style="list-style-type: none"> <li>• the teacher moves easily and equitably around the room, observing and talking to students, individually and in small groups;</li> <li>• the teacher scans the room to evaluate progress and identify students who need help</li> </ul>	<p><i>SPACIOUSNESS</i> to enable easy movement around the room and to access all students</p> <p><i>ACTIVE SURFACES</i> for viewing student progress and ideas</p>

environments (Lee & Tan, 2011; Pearhouse et al., 2009; Radcliffe, Wilson, Powell, & Tibbetts, 2009). However, the majority of evaluation processes are overly complex, requiring specialists to implement them and often do not address fundamental issues relating to pedagogical objectives. Consequently very little meaningful evaluation ever occurs.

The Effective Teaching and Learning Spatial Framework (ETLSF) presented an opportunity to develop an evaluation tool that was simple to apply, addresses key pedagogical objectives, behaviour and spatial qualities. Furthermore, the evaluation outcomes present a clear indication of the efficacy of a learning space for implementing effective teaching and learning. The ETLSF was dissected to establish 25 statements separated into the following four categories: Furniture, Engagement, Technology and Pedagogy.

With a particular learning space in focus, participants were asked to respond to statements according to a standard Likert Scale that differentiated the level of agreement with each statement, where 1 = significantly disagree and 5 = significantly

agree. The higher the rate of agreement with the survey statements, the better suited the physical environment was for implementing effective teaching and learning. A low rate of agreement with the survey statements indicated that the physical environment was not well suited to implementing effective teaching and learning.

Each response attracted a numerical value, with a maximum total of 125 points, aggregated to a percentage number that formed an efficacy rating of the learning space, or how effective a learning space was for enabling effective teaching and learning. For example, a total response of 100 points equalled 80%, resulting in an 80% efficacy rating for enabling effective teaching and learning. A learning space was considered well suited to enabling effective teaching and learning if the evaluation response achieved an efficacy rating of over 80%.

A degree of subjectivity was required by each respondent when deciding whether they 'agreed' versus 'significantly agreed', or 'disagreed' versus 'significantly disagreed'. However the writer was confident that this would not cause substantial differentiation between evaluation responses. As long as participants' responded to each statement with true and honest intentions, the results would likely provide a compelling sense of how well suited the environment was for applying effective teaching and learning practice.

Several statements were framed in terms of how 'possible' it was to enact certain activities within the learning space. In this context what is possible is a critical concept relating to the potential of learning space rather than relying upon observations of what actually occurs. The presence of a new generation learning environments may enable effective teaching and learning, but does not guarantee that effective teaching and learning will occur. There have been many observations of predominantly didactic teaching practices occurring in new generation learning environments, despite the intentions of the environment being to foster activity and collaboration. The learning environment may enable a specific educational approach, but if the teacher chooses not to adopt that approach, the possibility of practicing effective teaching and learning has nonetheless diminished.

The primary purpose of the Effective Teaching and Learning Evaluation Tool (also known as RateMyClassroom) is to confirm the presence of spatial characteristics and possible learning activities that are associated with effective teaching and learning. It may also be used as a checklist for designing new generation learning environments and a further purpose of prompting teachers to reflect upon their teaching practice by implementing behaviours embedded within the evaluation statements. The goal for designers should be to design learning spaces to achieve an efficacy rating equal to or greater than 80%.

## FINDINGS/RESULTS

RateMyClassroom was tested by the writer on three new generation learning environments: (1) the Learning Lab at the University of Melbourne; (2) Room 241 in

THE EFFECTIVE TEACHING AND LEARNING SPATIAL FRAMEWORK

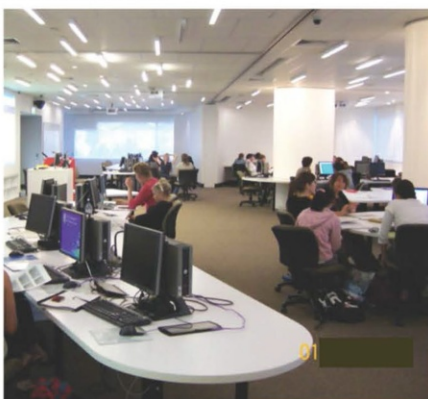
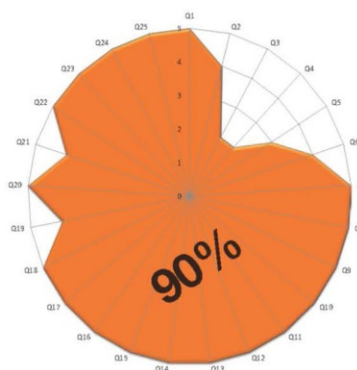
On a scale of 1-5, to what degree do you agree with the following statements						
#	(1 =completely disagree and 5 = completely agree)	1	2	3	4	5
<b>FURNITURE</b>						
1	The classroom is spacious. That is, the teacher can move around the room <i>easily</i> and access all students <i>equally</i> .					
2	Students can move around the room to communicate with other students.					
3	The furniture is mobile and can be easily moved.					
4	There are different types of furniture settings in the classroom (that would enable different types of activities).					
5	It is possible to reconfigure the room for different activities.					
6	It is possible for students to shift furniture around to suit their learning activity.					
<b>ENGAGEMENT</b>						
7	It is possible for the teacher to engage with students individually.					
8	It is possible for the teacher to engage with small groups of students.					
9	It is possible for the teacher to engage with the whole cohort.					
10	It is possible for students to engage easily with each other, for example through discussion.					
11	It is possible for students to conduct collaborative activities.					
12	It is possible for students to communicate with each other in different ways.					
13	It is possible for students to undertake focused tasks during class.					
<b>TECHNOLOGY &amp; RESOURCES</b>						
14	There are educational technologies in the room that are accessible by students (such as digital screens or data projectors).					
15	It is possible for students to access a variety of resources in the classroom, e.g. whiteboard, digital screen, document camera, internet, computer/tablet, etc.					
16	Students have choices as to the types of resources they have access to.					
17	It is possible for multiple groups of students to access multiple technologies at the same time.					
18	It is possible for students to write and share content on writeable walls or digital surfaces (active walls).					
19	It is possible for students to share/record/save content discovered or created in class, for future reference.					
<b>PEDAGOGICAL AGILITY</b>						
20	It is possible for individual students to undertake different activities simultaneously.					
21	It is possible for students to utilise vacant floor space for learning activities (active floor).					
22	It is possible for groups of students to undertake different group activities in the same space at the same time. For example, one group can create content on a digital screen while another group builds a model.					
23	Students have the freedom to instigate their own activities that are relevant to them.					
24	It is possible for students to work at their own pace during class.					
25	It is possible for the teacher to observe and monitor students at a distance (so as not to interrupt them), to evaluate their progress on class activity.					
<b>EFFICIENCY RATING</b>			<b>0%</b>			

Figure 1. Effective teaching and learning evaluation tool, RateMyClassroom

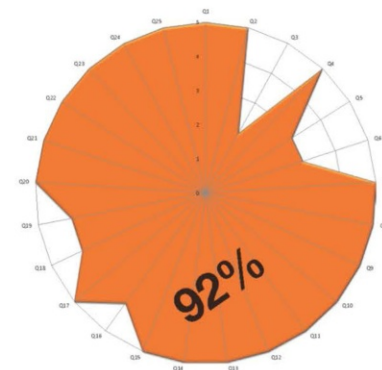




The Learning Lab, University of Melbourne  
Photo source: Jo Dane



Rm 241, Collaborative Teaching & Learning Centre,  
University of Queensland, Photo source: Jo Dane



Rm 352, Collaborative Teaching & Learning Centre,  
University of Queensland, Photo source: Jo Dane

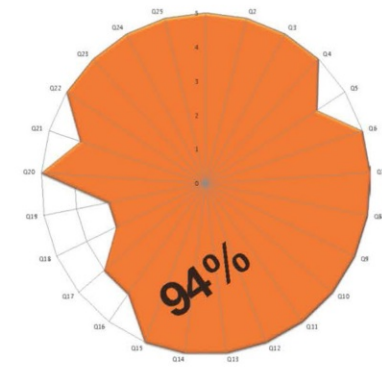


Figure 2. Examples of new generation learning environments

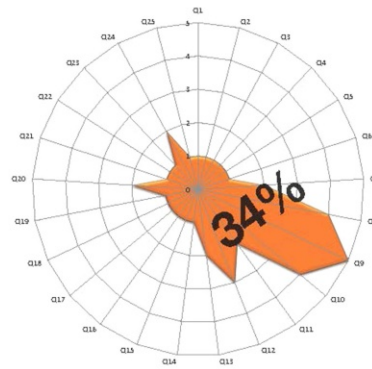


the Collaborative Teaching and Learning Centre at the University of Queensland; and (3) Room 352 in the Collaborative Teaching and Learning Centre at the University of Queensland. The evaluation did not require an observation of a teaching episode in order to isolate the potential of the classroom from the teaching and learning practice that actually occurs.

Each of the three new generation learning environments scored 90% or above resulting in the conclusion that all of the evaluated classrooms were highly aligned with the principles of effective teaching and learning (refer Figure 2). It was therefore assumed that each classroom would enable teachers to implement a wide variety of active, collaborative and technology-rich activities that collectively exemplified effective teaching and learning. Each tested new generation learning



Typical Lecture Theatre  
Photo source: Jo Dane



Typical Tutorial Room  
Photo source: Jo Dane

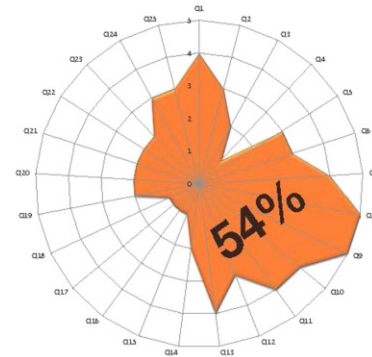


Figure 3. Examples of traditional learning spaces

environment presented spatial qualities that promoted movement of teachers and students around the room, a multiplicity of technologies, equitable access by students to technologies and other room features, and the ability for a variety of different activities to take place asynchronously. This presented the opportunity for teachers to facilitate an extensive array of activities that would increase the likelihood of students engaging deeply with the content, and to develop deep understanding of learning concepts.

The results emanating from evaluations of traditional learning spaces such as lecture theatres and tutorial rooms were particularly interesting. These classroom typologies have dominated educational buildings for decades, built on the premise of an efficient method of teaching to large numbers of students. As Bligh and others have asserted, lectures are not an effective format for student learning (Bligh, 1972; Penner, 1984; Ramsden, 2003). With such condemnation directed towards the lecture/tutorial model, the writer was curious to evaluate traditional learning spaces through the same lens as the new generation learning environments.

RateMyClassroom revealed numerous and considerable limitations of the traditional classroom typologies. Mobility by students was drastically constrained, activities were limited to the teacher-centred technologies in the room, and the potential to implement collaborative learning or asynchronous activities were made difficult, if not impossible, by the typical furniture settings. A tutorial room, which assumed some degree of furniture mobility (although rarely changed) yielded an efficacy rating of 54%; whereas a lecture theatre, with fixed seats all facing the lectern and presentation screen, achieved an efficacy rating of only 34% (refer [Figure 3](#)).

## CONCLUSIONS

The evaluation results indicated that new generation learning environments could demonstrably support a diverse range of pedagogical possibilities, significantly more so than traditional learning spaces. The low ratings of lecture theatres and tutorial rooms called into question the value of the student learning experience in what has until now epitomised the higher education learning experience. If a university's objective is to improve the quality of teaching and learning, then a clear example of how this may be fostered on campus would be to promote effective teaching and learning practices within new generation learning spaces, and decrease the reliance upon lectures and tutorials. While the writer recognises the difficulties inherent in reducing lectures within a university environment because they efficiently provide access to course content for large numbers of students, developments in online instructional content are now presenting universities with alternatives in distributing mass content.

The Effective Teaching and Learning Spatial Framework and RateMyClassroom evaluation tool articulate effective teaching and learning practice, desirable learning behaviours, and identify spatial characteristics that enable optimum teaching practice

and student engagement. A multiplicity of purposes emerged through the statements embedded in the evaluation tool. It promises to have an impact beyond the simple evaluation of a single learning space, relating specifically to teachers, designers of future new generation learning environments and other university stakeholders.

For teachers it will:

- Prompt reflection on their teaching and learning practices;
- Prompt consideration of how both they and their students engage with the physical environment to support and foster effective teaching and learning.

For designers it will:

- Prompt them to ensure that appropriate spatial characteristics are incorporated into the formal classroom design, to enable effective teaching and learning;
- Raise awareness of the effective teaching and learning behaviours to be sought and enabled in an active classroom.

For other university stakeholders it may:

- Enable facility managers to evaluate new classrooms to investigate whether they are being used in ways that foster effective teaching and learning and support financial reporting cycles;
- Enable researchers to align with related research that measures student engagement, such as Scott-Webber, Strickland, & Kapitula (2013) and Freeman et al. (2014).

The RateMyClassroom evaluation tool provides a simple, easy-to-use instrument for evaluating and designing all learning spaces, but in particular new generation learning environments, to confirm the suitability of the environment for implementing effective teaching and learning. By adopting this tool, universities can establish benchmarks for design by specifying that new generation learning environments should achieve, as a minimum, an 80% efficacy rating. The quality of teaching and learning will improve as the presence of new generation learning environments increases across university campuses, enabling teachers to facilitate effective teaching and learning and enhance the student learning experience.

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## AFTERWORD



*Melbourne University  
Photo courtesy of Hayball Architecture  
Photo credit: Peter Clarke Photography*

## 16. THE EMERGING IMPORTANCE OF THE AFFECTIVE IN LEARNING ENVIRONMENT EVALUATIONS

This Afterword posits an emerging but critical discourse in learning environments evaluation, suggesting a realm of exploration the editors believe will gain significant traction in coming years. Discussed through the work of Sarah Healy, it takes us into the realm of human environment relations, an area of research that is within the respective realms of the EDRA (the Environmental Design Research Association) and also as evident in the *Journal of Environmental Psychology*. These both explore the evidence base behind the inhabitation of environments and the affect it has on occupants.

This is in contrast to the all too minimal focus in schools of the impact of architecture on human environment relations, where design is focussed principally on the physical object, rather than the functionality of the space and also those spatial qualities that impact on human wellbeing. If the cliché ‘form follows function’ is to be respected, then there should be much more focus on the functionality and how this relates to the nature of human inhabitation of these forms.

This focus is also being recognised in an emerging discipline of Building Wellness Evaluation. Indeed this is accompanied by a programme which will certify building wellness evaluation professionals in much the same way that buildings can be certified for environmental sustainability through Building Research Establishment Environmental Assessment Methodology (BREEAM), Leadership in Energy and Environmental Design (LEED) and GreenStar ratings assessments (see <http://www.wellcertified.com>).

As ubiquitous broadband wifi penetrates learning programmes through interactive online courses such as MOOC’s (massive online open courseware) in universities, and now in schools, with other online sources such as Perfect Learning (<http://www.perfectionlearning.com>), subject and course material can be accessed from anywhere at anytime by anyone. This brings in to sharp focus the concept of place-based learning and the role of the school campus and its buildings. That is, what are the physical affordances students and teachers need when using online collaborative and inquiry-based tools?

We now have to understand more deeply the differentiation between schools and schooling, where the latter represents the types of graduate students the State aspires to achieving in its young student cohorts. The school itself needs to respond to these



aspirations, where teachers, resources, curriculum and technologies all need to be integrated to offer a collective affordance to achieve the desired schooling outcomes.

But with the impact of social media and online interactive learning effectively balkanising central controlling mechanisms, the physical place-based experience is becoming even more critical to understanding face-to-face human interactions. Balkanisation of schools themselves is occurring with slight increases in home schooling, but also the rapid emergence of charter schools in the USA and free schools in the UK and Europe, all responding to these disruptive schooling forces.

Paradoxically school learning environments are becoming a re-generated form of social capital, where knowledge is co-constructed face-to-face, students and teachers are reconnecting to a previously shunned external community context and, conversely, the community is wanting to have a stronger stake in life long learning and access to learning resources. This is also exemplified in the new energy and funding going into public libraries, art galleries, museums, sporting facilities, botanical gardens and other social infrastructure which not only contribute to social capital but also to cultural capital.

The school has figuratively been a key part of this social infrastructure network, but it is likely to take a much stronger role as classroom-based and bounded pedagogical practice begins to make much more robust use of a wider range of physical learning opportunities in the communities that surround the school.

This is likely to rejuvenate the engagement of students in active learning opportunities, in contrast to the passive classroom environment, and this is likely to have a marked impact on the affect of both students and staff in their learning programs and activities.

*Snapshots* illustrates that a diverse approach to evaluation of learning environments is required to match the complexity of 21st century learning and teaching. What is apparent from previous chapters is the way these suggested evaluations tend to focus on the effective. This is required, as evidence has traditionally been related to the empirical.

However, 21st century scholarship is pressing the need to better account for the affective in design and in education, to give acknowledgement of the experience people have in our learning environments. The question arises, what approaches open the door to the iterative, transitory, affective qualities of how people inhabit educational space/s?

Healy's chapter intuitively points to a possible link between affect and engagement, and it is through a lens of an evidence-based use human environment relations research in learning environments that we may see some radical shifts in what has been an entrenched industrial age model of school designs and schooling. Her perspective moves us beyond not only traditional evaluation issues, methods and knowledge, but into a space where the very nature of the learning environment is questioned.



## IMPORTANCE OF THE AFFECTIVE IN LEARNING ENVIRONMENT EVALUATIONS

Healy does this in a manner that allows knowledge gleaned through an affective approach to feed back to more conventional educational settings. Her chapter is presented as an 'afterword'; it moves our thinking into the possible. It should equally be classified as constituting a 'foreword' of the types of evaluations we must embrace in years to come. Watch this space!

SARAH HEALY

## 17. EVALUATING SPACES OF PEDAGOGIC AFFECT

### INTRODUCTION

I have a teenaged son. A few months ago he came home announcing that he wanted to go to a different school. Then, after a school tour he back-flipped saying: “Mum, I can’t go to that school.” When I inquired why, he said, “I don’t like the feel of it”. And I got it. Truth be known, I didn’t like the feel of it either. So what was it about that school’s environment that affected my son in such a way? Was it the cold? The smell? The green lino? The serious demeanor of the students? The old style classrooms? The greasy humidity of the canteen? The institutional grey of the music block? The clanging school bell that made us all jump? Most likely it was the complex interplay (or intra-play) of all these things and more that made the school feel the way it did.

This brief encounter raises certain questions: What makes a learning space attract rather than repel? And lure somebody in? And invite someone into a pedagogic experience? How does it acquire the hallmarks of a pedagogic masterpiece? And how do we investigate this when its primary concerns are often ephemeral and non-representational phenomena like affect and affective atmospheres? And how will investigating this grow our understandings of learning spaces, pedagogies, their affects, and what they do? And why is this important?

These are tricky questions that elude a simple response. At the same time it is questions like these that have the capacity to catalyse into new knowledge and practice, but only for those brave or foolhardy enough to wrestle with them. This final chapter is a brave (but hopefully not too foolhardy) proposition to do just this. The result is the development of a trajectory for future pedagogic and learning space evaluation that departs from pervasive social constructivist, cognitivist and behaviouralist approaches to education. As an exemplar of what this may look like I present a snapshot of a multiple-case PhD study investigating pedagogic affect across heterogeneous contexts such as sports clubs, sculpture walks, historic sites, museums and playgrounds. Key concepts such as pedagogical force, scenes of pedagogical address (Ellsworth, 2005), and the materiality of affect are put to work through a practical engagement with broadly conceived spaces of learning that move beyond bounded notions of learning spaces and their pedagogies. The notion of ‘beyond’ itself becomes a thread running through much of this chapter, with concepts such as more-than-human, more-than-representational, beyond anthropocentric pedagogy, and beyond the pedagogic encounter underpinning its onto-epistemology.

## CONTEXT

*Beyond a 21st Century 'grammar of schooling'*

Learning spaces are gaining increasing attention with associated notions of 'innovation', '21st century learning' and the perceived need to address outmoded industrial modes of schooling proliferating in public and policy discourse. This is reflected in the titles of Australian government and OECD documents such as: *Pedagogy and Space: Transforming Learning Through Innovation* (DEECD, 2009), *21st Century Learning: Research, Innovation and Policy* (OECD, 2008), and *Innovative Learning Environments* (OECD, 2013). Accompanying ideas of 21st century innovation and learning is the widely circulated proposition that 'schools are preparing students for jobs that don't exist yet'. The connotations are that, to meet the future focussed needs of the 21st century learner, new (innovative) pedagogies and learning spaces need to be developed that foster competencies such as: creative, innovative and critical thinking; problem solving; decision-making; learning to learn/metacognition; communication; collaboration; information and ICT literacy; global and local citizenship; personal and social responsibility (<http://www.atc21s.org>).

Yet, with the exception of information and ICT literacy, history's plentiful examples of learning space innovation show that contemporary 'innovative learning environments' (ILEs) and their corresponding pedagogies are not as innovative as the name implies. The following are all historical examples of pedagogical and learning space innovation: traditional Australian Aboriginal learning on country (at least 50,000 years of continuous culture), The Idiot Teacher and Prestolee (1918–1953), Mabel Chrystie's First Street School (Founded 1964), Italy's Reggio Emilia movement (Post WWII), and Steiner schooling (1919 onwards). As Hattie (2008) aptly observes, there has been no shortage of innovation in education, just a shortage of ongoing demand for innovative programs (p. 2). Indeed, the very notion of innovation in education is problematic (Blackmore, Bateman, O'Mara, Loughlin, & Aranda, 2010; Resnick, Spillane, Goldman, & Rangel, 2010). One reason is that sedimentations of social, spatial, material, relational and temporal pedagogic assemblages create a 'grammar of schooling' (Tyack & Tobin, 1994) and an associated 'grammar of pedagogy' that is resistant to change. Pedagogic routines and practices that have long existed, come to constitute perceptions of what 'real' pedagogy is, and what it should be – re-materialising in pedagogic routines and practices to come (Lenz Taguchi, 2010).

The current policy and research focus on ILEs and ILE related discourse can be seen to be creating a new grammar of schooling by promoting one incarnation of learning space innovation while distracting attention from the many 'innovations' that have gone before and those presently happening. It positions schools and ILE discourse at the centre, pushing more broadly conceived pedagogic spaces to the periphery. This creates blind spots in the learning space evaluation field, limiting the possibilities that may arise. In order to bring such blind spots into view, there

is a need to move beyond bounded notions of the ILE by taking a more gestalt approach to learning space research (Healy, Grant, Villafranca, & Yang, 2015). Such an approach is defined as analysing “the totality of a particular situation and its constituent parts in relation to one another (Wollants, 2008) where ‘all contact is creative adjustment of the organism and environment’” (Harris, 2010, p. 19). For learning space evaluation this means acknowledging that learning is not confined to school and school-based pedagogies but emerges through heterogeneous pedagogic encounters (human and non-human) that occur in a variety of settings.

### *Towards the Affective*

How pedagogic affect influences the effectiveness of learning spaces is also an important consideration for future learning space evaluation. The role of the affective dimension of learning has been gaining increasing attention in educational circles. This is reflected in the identification of “learners’ motivations and importance of emotions” as one of seven learning principles that underpin the OECD’s recently developed ILE framework (CERI, 2015). Current and emerging curriculums across Australia are also recognising the value of Social and Emotional Learning (SEL). For example, within Australia the Victorian curriculum aims to develop students’ personal/emotional and social/relational capacities through one of four cross-curricular capabilities, ‘The Personal and Social Capability’ (VCAA, n.d.). This is supported by related literature on SEL that shows evidence of a range of personal, social, behavioural and academic benefits from effective SEL programs in schools (Farrelly, Forster, & Smith, 2014).

However, the framing of emotions in the OECD’s ILE framework, the Victorian curriculum, and much of educational literature uses psychology-based definitions of emotion and affect. Correspondingly, SEL pedagogies remain located in cognitivist and social constructivist domains. In contrast, I argue the need for the learning space evaluation field to consider the potential of alternate approaches to investigating the role of affective pedagogic spaces. The proposed research trajectory presented adopts an approach that leverages off Deleuze/Guattarian understandings of affect, generating possibilities for analysing affective pedagogic spaces in terms of intensities, atmospheres, forces, flows, and becomings that materialise in embodied responses and changes to what a body has the capacity to do. This approach is informed by the growing body of interdisciplinary literature on affect that has led to the so-called ‘affective turn’ in social theory (Clough & Halley, 2007).

### *Towards the Spatial*

The ‘affective turn’ follows a similarly interdisciplinary ‘spatial turn’ that has led to the identification of what Fisher (2004) describes as “a deep spatial silence” at work in schools (p. 36). A subsequent spatial project has been to restore a spatial consciousness to the temporal and social by highlighting how space is integral to

understanding these concepts. The resulting “three-sided sensibility of spatiality-historicity-sociality” (Soja, 1996, p. 3) has productively led to diverse critical analyses of socio-spatial practices in the education field (Gulson & Symes, 2007; McGregor, 2004a). The focus of spatially orientated research is determined by how space is used as a conceptual tool, which in turn is determined by how space itself has been framed. The framing of space for this proposed research trajectory is primarily, but not exclusively, informed by post-structuralist and new materialist conceptions of space (for example: Soja’s (1996) notion of the third space as a site of radical openness and Barad’s (2007) understanding of matter and the material). In this way I am proposing a research trajectory for evaluating learning spaces and pedagogies that aligns with the educational contexts of both the affective and the spatial.

### *Towards the More-than-Human*

The rise in interest in affect and space in education is underscored by a move towards posthuman (or more-than-human) research approaches drawing on the sociomaterial (Fenwick, Edwards, & Sawchuk, 2011), new materialisms (Coole & Frost, 2010; Fox & Alldred, 2015), and material feminisms (Alaimo & Hekman, 2008). A common thread running through these interrelated paradigms is the understanding of the material and social as being inextricably enmeshed. The human is no longer privileged and the material not relegated to the background. This sets the premise for rethinking affective and spatial relations creating the conditions for realist vs social constructivist debates to shift to ‘emergent interplay’, rejecting mind/body, social/material and material/discursive binaries (Jackson & Mazzei, 2012, p. 114). This is to “release and redirect the forces now locked up in such binaries by addressing them ... as complex, moving webs of inter-relationalities” (Ellsworth, 2005, p. 3) and is useful because it fosters dynamic re-imaginings of educational practices that are not limited to dominant instrumental approaches to pedagogy (Lenz Taguchi, 2011).

### *Towards More-Than-Human Pedagogues and Pedagogies*

Barad (2007) notes that in a posthuman sense material and human *agencies* are mutually formative and emergent: *agency* is not possessed but distributed across the human and non-human as an emergent enactment (Jackson & Mazzei, 2012, p. 117). If this agential logic is applied to pedagogy it follows that material and human *pedagogies* are mutually formative and emergent: *pedagogy* is not possessed but distributed across the human and non-human as an emergent enactment. Human teachers can no longer be assumed to be the primary pedagogue in all situations – rather pedagogy emerges out of mutually constitutive assemblages of bodies, materials, media, affects, atmospheres, and space. Therefore a focus of

this proposed research trajectory is how the complex choreography of these inter-relational and intra-relational components create what Ellsworth (2005) refers to as ‘the force of pedagogy’ (p. 35) and what I call pedagogic affect.

#### MOVING FROM AN ABSTRACT TRAJECTORY INTO CONCRETE RESEARCH

The affective, spatial and more-than-human contexts presented help establish the need for research that evaluates learning spaces to transcend limited conceptions of pedagogy and learning spaces by accounting for “how life takes shape and gains expression in shared experiences, everyday routines, fleeting encounters, embodied movements, precognitive triggers, affective intensities, enduring urges, unexceptional interactions and sensuous dispositions” (Lorimer, 2005, p. 84). Doing so addresses a blindness towards spatial (Fisher, 2004), non-linguistic (Ellsworth, 2005), and material (Fenwick et al., 2011) influences on educational practice while affording a more nuanced understanding of the mutual becomings of built and naturally occurring pedagogic spaces, inhabitants, and affective flows.

At the same time certain questions emerge: how does a trajectory that seeks to move beyond bounded notions of the learning environment, the pedagogue and pedagogy manifest in evidence-based research? And, what does an approach that accounts for the embodied experiences of the affective, spatial, relational and material look like? The following PhD research design provides a concrete example of how such a study may manifest, showing one of many possibilities for such a research trajectory.

#### *An Exemplar: PhD Research into Heterogeneous Spaces of Pedagogic Affect*

The exemplar I present is a PhD study about how pedagogic affect works across diverse learning contexts. It takes the form of a multiple-case study and is a direct example of what research following a spatial, affective, material and relational trajectory might look like. The precedent for the research is set by literature pertaining to pedagogic affect (Baker, 2008; Ellsworth, 2005; Hickey-Moody & Crowley, 2010; Hickey-Moody, 2013b; Kraftl, 2015; Watkins, 2006; Zembylas, 2007a) that shows cause for evaluating how affect and affective learning spaces can be designed to create ‘pedagogical masterpieces’ (Ellsworth, 2005). Drawing on a range of theorists that align with a non-representational approach, the PhD research puts concepts of affect and space to work. It adopts a Deleuzian understanding of affect while also referencing Ellsworth’s (2005) *Places of Learning: Media, Architecture, Pedagogy*. Although Ellsworth’s work pre-dates non-representation theory and does not draw on Deleuze, her work embodies the spirit of what the PhD research is trying to achieve and of what future pedagogic and learning space evaluation needs to capture.

*What does the Literature say about Heterogeneous Spaces of Pedagogic Affect?*

A literature search around the key constructs related to the geographies of pedagogic affect reveals little engagement with how pedagogic affect emerges across heterogeneous spaces of learning. Although there are studies investigating broadly conceived learning spaces, there is a general absence of *comparative* studies looking at pedagogic affect across a variety of different contexts. There is, however, a large volume of educational literature concerning the core concepts of space, pedagogy and affect. The following (very brief) review of the literature looks at where these concepts converge in interconnecting arenas of ‘space and pedagogy’, ‘space and affect’, and ‘pedagogic affect’, culminating in a comment about embodiment and affect.

*Space and Pedagogy*

Historically, learning spaces have been perceived as the built environment, operating as a backdrop to the teaching and learning that takes place within. As such they were treated as “a material location in which education research is located” (Leander, Phillips, Taylor, Nesor, & Lewis, 2010, p. 331). Now, thanks in part to theoretical developments by the geographers, learning spaces are no longer taken as inert containers of learning but are understood as products of mutually constitutive socio-spatial dialectics: “a dynamic multiplicity that is constantly being enacted by simultaneous practices-so-far” (Fenwick et al., 2011, p. 11). They are widely considered as physical, conceptual and/or virtual spaces of learning that can be seen as networks, systems or ecologies, hence the related term ‘learning environment.’ It is within this Lefebvrian (1991) conception of learning spaces that the links between inhabitation of physical learning spaces and their associated pedagogies are explored in this literature review.

With the exception of work by Byers and Imms (2016), researchers from a range of methodological backgrounds have argued there is no direct causal relationship between learning spaces and learning outcomes or teacher change (Blackmore et al., 2011; Hattie, 2008; Mulcahy, Cleveland & Aberton, 2015). However, it has been shown that “learning spaces can produce conditions and mediate relationships that can improve student learning” (Blackmore et al., 2011, p. 4), and further claims have been made regarding a critical link between the material learning space and student learning (Bruce Mau Design, 2010). Yet Blackmore et al.’s (2011) comprehensive literature review of learning spaces and student outcomes found little empirical research on how school spaces are used pedagogically to improve learning. Since then, further school-based studies have been conducted that address this gap and improve understandings of the relationships between spaces and pedagogies, for example: Deed and Lesko (2015); Dovey and Fisher (2014); Mulcahy et al. (2015); Saltmarsh, Chapman, Campbell, and Drew (2015); and Woolner, Clark, Laing, Thomas, and Tiplady (2014). Interestingly, these studies show that the inhabitation



of newly designed learning spaces does not necessarily lead to progressive change in pedagogical practice. To the contrary, Dovey and Fisher's (2014) study found new school designs can in fact camouflage conservative pedagogies. The complex ecology of learning spaces would suggest that looking for simple causal effects between pedagogy and space is misguided. Rather, seeking to understand the meshwork (Ingold, 2011), of socio-material inter- and intra-relations at work in learning spaces may be a more generative path. Even so, a case has been made for quasi-experimental research seeking correlations between space, pedagogy and student outcomes (Byers, Imms, & Hartnell-Young, 2014).

While the extent to which space influences teaching and learning is contested, it is widely accepted that pedagogy itself plays a crucial role in student outcomes. According to Hattie's (2008) synthesis of over 800 meta-analyses, what the teacher does and does not do has the single greatest effect on student learning outcomes in schools. While this is a strong, empirically backed statement, it still begs the question: Is it all about the pedagogue, the pedagogy or the pedagogic assemblage? And who/what is the pedagogue anyway? If we adopt a relational materialist view of pedagogy we can begin to understand it not as a thing that is possessed and performed by (human) teachers, but as a material process distributed across human actors and material actants. This recognises the mutually formative nature of human/material pedagogies while expanding our pedagogic vernacular to encompass the likes of architecture, art, exhibitions, playground design, sport, media, music and performance. From this position anthropocentric (human centred) and logocentric (language centred) pedagogical approaches, commonly associated with behaviouralist, cognitivist and social constructivist pedagogies (Lenz Taguchi, 2011, p. 210) are opened up to more-than-human and more-than-representational possibilities. A relational materialist understanding exposes how pedagogies and spaces are intertwined while creating room for broader conceptions of learning spaces and their pedagogies that extend beyond school.

It is worth noting there is a related body of educational literature concerned with heterogeneous spaces, places and to varying degrees the relational materialities of pedagogy. These studies reflect a rich landscape of pedagogy resulting in valuable outcomes. Some invite a change of heart towards children and their spaces of inhabitation (Burke, 2008), others show how parents can learn collaboratively with their very young children in the public space of an art museum (Ross, Hancock, & Bagnall, 2004), and others critically examine space-power relationships – highlighting teachers' seen and unseen pedagogies at work through spatial practices (McGregor, 2004b). All draw our attention to space, place and the materiality of the learning in significant ways while starting to unpack what McLeod (2014) identifies as the "multilayered, iterative relationship" (p. 134) between pedagogy and learning space design. These studies show the potential of looking to heterogeneous learning spaces for better understandings of how space may be used pedagogically to improve learning.

Yet, because of a focus on the development of individuals (Fenwick et al., 2011, pp. 5–6) even the most materially orientated of these studies can also be seen to examine educational practices that are underpinned by instrumental, human centred, language centred pedagogies. The problem with this being that by putting humans at the centre blinds us to the material and relational forces in the pedagogic event, leading to an overemphasis on language as a way to understand pedagogic processes (Lenz Taguchi, 2011, p. 212). An alternative approach is to see pedagogy (and therefore learning) as emerging from distributed networks and assemblages. This relocates pedagogy and learning from within human individuals to a liminal space of intra-activity that occurs in-between bodies and material artifacts, affects, atmospheres and spaces (Lenz Taguchi, 2011, p. 221). This way of thinking about pedagogy leads to the notion of ‘the pedagogic encounter’ as being central to thinking and learning. This means learning can be seen as emerging from encounter/s between bodies (non-human and human), material artifacts, affects, atmospheres and spaces. Paying specific attention to the encounter is important because it affords an understanding of “the stability of form amid the dynamism of formation” (Anderson & Harrison, 2012, p. 19).

*Space and affect.* Affect and space can be understood as inter-related and co-constitutive. Affects do not simply reside inside bodies or things but have an autonomy that allows them to flow between bodies and things. In this sense affects make spaces (Bissell, 2012, p. 81), while spaces configure affects. That is, spaces are affected and affect, are conditioned and condition. An excellent example of how concepts of space and affect are generatively worked together is Bissell’s (2012) investigation into the uncertain geographies of pain. His emphasis on the temporal and spatial characteristics of affect allowed him to explore the affective topologies of pain revealing the conditions for different affects to emerge, changing “the realm of possibility for the body in pain” (Bissell, 2012, p. 82). Likewise studies concerned with the affective topologies of pedagogy may benefit from the adoption of Bissell’s approach, potentially ‘changing the realm of possibility for the body’ in education.

*Pedagogic affect.* Pedagogic affect is a relatively recent area of educational interest. With the potential for affect to reconfigure education in significant ways not yet fully realised, it can arguably be considered “an emerging point of intervention and analysis” (Hickey-Moody & Crowley, 2010, p. 401). Pedagogic affect can be understood simultaneously as material entity and a mode of cognition, working as an “interleaving of affect and cognition” (Ellsworth cited by Hickey-Moody & Crowley, 2010, p. 403). This framing of affect works in a two-fold way. Not only does it break down (problematic) affective/cognitive binary in education but it also provides an entry point for different accounts of affect theory to engage with each other. Defining pedagogy as the interleaving of affect and cognition opens the door for philosophical approaches to affective pedagogies to (re)engage with the likes of

social psychology and occupy an interdisciplinary space, not limited by theoretical affiliations.

Classroom practice has been the focus of much educational literature related to pedagogic affect (see for example: Albrecht-Crane & Daryl Slack, 2003; Mulcahy, 2012; Mulcahy et al., 2015; Skattebol, 2010; Walshaw & Brown, 2012; Watkins 2006, 2011; Youdell & Armstrong, 2011; Zembylas, 2007a). This is understandable given classrooms are the main spaces of learning in contemporary schooling, however a narrow focus does not account for the range of affect-laden pedagogic phenomena that may be encountered. Where the literature ventures into other domains, there seems to be limited exploration into how pedagogic affect plays out comparatively across different contexts. While museums are increasingly being recognised for their affective pedagogic capacities (Baker, 2008; Ellsworth, 2005; Mulcahy, in press) there is still an absence of literature exploring the *comparative* affects arising from pedagogic encounters occurring across a variety of pedagogic vernaculars such as performance, design, art, music, sport, architecture and film.

*Embodiment and affect.* Zembylas (2007b) argues the mind/body Cartesian split has led to ignoring bodies and affect in education. However affective embodied learning is known as an integral component of the emergent learner: “The lived experience of learning is always affective; whether learning how to conjugate a verb in a classroom (Watkins, 2012) or how to dance in a nightclub (Henriques, 2010), our bodies and their affective registers are the flesh of pedagogy” (Hickey-Moody, 2013b, p. 126). Further, bodies have affective responses to the spaces they inhabit, they simultaneously affect and are affected by those spaces. Mulcahy adds, “bodies are a chief site of securing the circulation of affects” finding affective pedagogic encounters in the museum have the power to engender learning that ‘sticks’ with the learner (Mulcahy, in press). Along similar lines, Zembylas points out that a Deleuzian conceptualisation of bodies and affects has the power to transform pedagogy into something “that engages students’ and teachers’ bodies and affects in a ‘love affair’ with bodies of knowledge” (Zembylas, 2007b, p. 28).

*Summary of literature.* A historical neglect of the affective and spatial in education has created room for further research into how affective space may be pedagogically worked to improve learning. The literature suggests affect is key to understanding how the spatial, material, relational and pedagogical work in concert yet reveals limited investigations into how this plays out comparatively across different heterogeneous learning spaces. The findings from previous research build a case for investigating heterogeneous learning spaces (Ellsworth, 2005; Hickey-Moody, 2013b) while arguing the need for “more theoretically diverse considerations of pedagogy in education” (Hickey-Moody, 2013b, p. 121). This reiterates the need for research that adopts a relational, more-than-human, and more-than-linguistic understanding of the pedagogue and associated pedagogies while recognising the affective, spatial, and material as modes of pedagogical address (Ellsworth, 2005;

Hickey-Moody, 2013b). It also shows a need for research that accounts for how learners are implicated in affective pedagogies of space, with the literature suggesting that this might be achieved by considering the pedagogic encounter as an intricate spatial, material, relational and affective assemblage.

### *How does this Shape the Design of Research into Heterogeneous Spaces of Pedagogic Affect?*

It can be surmised that the literature discussed not only supports a research trajectory for learning spaces and their pedagogies that accounts for the affective, spatial, material and relational but also offers many possible entry points for designing research to this end. Returning our attention to the exemplar PhD study, we will now look at how research addressing these concerns may take shape. To be consistent with its onto-epistemology, such research emphasises relational processes, and therefore requires process driven research questions about *how* particular phenomena work in a given context and *to what effect?* This means looking beyond what does and doesn't work to investigating *how* it works (or doesn't work) and with what consequences. The resulting research questions for the exemplar PhD study are: How does pedagogic affect work across heterogeneous learning contexts? And, for whom?

Examining these research questions while highlighting the dynamic inter-relationships at play requires a methodology and method that are at once experimental and robust. The following section outlines the development of an experimentally robust methodology and method that may be utilised to do this in the context of the exemplar PhD study.

### *Methodology*

*Non-representationalism.* The research design itself is underpinned by a non-representational approach that is characteristically experimental in nature. Having been recognised for its potential for studying the likes of affect, atmospheres, performativity, relationality and spatiality, non-representationalism aligns well with this type of study. The corresponding theoretical framework sits under the umbrella of non-representational theory, a theory that can essentially be understood as a synthesis of diverse but inter-related theories from fields that include (but are not limited to) cultural geography, French philosophy, new material feminism, critical theory, and affect theory. It is described as “a hybrid genre for a hybrid world” (Vannini, 2015, p. 3) and it “seek[s] to engage and present (rather than represent)” (Cadman, 2009, p. 1). Non-representational theory can come in many guises depending on the theories chosen to work with. The two theories tied together to create the particular non-representational approach for this research are: spatial theory and a Deleuzian inspired theory of affect.

*Multiple-case study methodology.* To achieve the aim of showing how the phenomenon of pedagogic affect works across heterogeneous pedagogic assemblages, and how it manifests through different vernaculars such as architecture, performance, art, sport, and museum design a multiple-case study design, primarily using Yin's (2014) approach to designing case studies, has been adopted. The case is that of pedagogic affect and will be studied across four heterogeneous contexts. Replication logic is used and a holistic approach to the research design is used, resulting in a single unit of analysis (the affective pedagogic encounter). The multiple-case study as a methodology works well with non-representational research because it does not stipulate methods and is flexible enough to accommodate its experimental nature whilst providing a sound methodological framework to work within.

*Selection of research contexts.* The research contexts have been purposefully selected to form a collection of affect laden heterogeneous sites that express pedagogic intent through a variety of pedagogic vernaculars (see [Table 1](#)). In addition, each site has sufficient supporting documentary data available to the public suitable for documentary analysis. In order to fulfil the requirement of heterogeneity the research contexts are geographically and pedagogically diverse. Their locations include Victoria, New South Wales, Tasmania and New Zealand. The pedagogies associated with the sites are equally diverse. What they have in common is their capacity to affect. Yet, the way this affective capacity plays out across different sites remains to be seen. The pedagogic affect of a high intensity Taekwondo competition will likely be very different from the airy atmosphere associated with certain historic sites. Equally contrasting are the pedagogic mediums associated with each context. Even the same pedagogic medium (such as the built environment) will function differently across contexts. For example, the sports stadium that typically houses a Taekwondo competition operates very differently to a curated outdoor sculpture installation.

### *Method*

Hickey-Moody (2013a) argues that using affect as method offers “new mixtures of thought” and can “change research landscapes by shifting the registers on which particular issues or questions tend to be worked” (p. 85). Artistic research techniques such as the generation of photographic essays and soundscapes in response to the ‘data encounter’ provide aesthetically sensitive pathways for working with affect as method (Hickey-Moody, 2013a, p. 87) to create a research assemblage that in turn carries its own affective capacities. The exemplar PhD study combines art-based methods with more traditional qualitative methods such as documentary analysis and interviews as used in sensory ethnography (Pink, 2015) to achieve the ultimate goal of experimental yet robust research.

*Table 1. Research contexts and participants*

<i>Context/site</i>	<i>Location</i>	<i>Participants</i>	<i>Pedagogic intent</i>	<i>Pedagogic medium</i>
Adventure Playground	Melbourne	<ul style="list-style-type: none"> <li>• Architect</li> <li>• Playground users</li> </ul>	<ul style="list-style-type: none"> <li>• Playground designers, Council guidelines,</li> <li>• Playground supervisors</li> </ul>	<ul style="list-style-type: none"> <li>• Built environment (playground equipment)</li> <li>• Natural environment (weather and trees)</li> </ul>
Taekwondo Club	Melbourne	<ul style="list-style-type: none"> <li>• Coach</li> <li>• Athletes</li> <li>• Researcher</li> </ul>	<ul style="list-style-type: none"> <li>• Coaches, Athletes</li> <li>• Club fit-out (interior design)</li> <li>• Event organisers</li> <li>• Event personal (e.g. referees)</li> </ul>	<ul style="list-style-type: none"> <li>• Physical training</li> <li>• Scheduling</li> <li>• Coaches</li> <li>• Fellow athletes</li> <li>• Competition events</li> <li>• Built environment (venues)</li> <li>• Equipment</li> </ul>
Historic Site	Tasmania	<ul style="list-style-type: none"> <li>• Tour operator</li> <li>• Curator</li> <li>• Visitors</li> <li>• Researcher</li> </ul>	<ul style="list-style-type: none"> <li>• Site/exhibition ‘curators’</li> <li>• Memorial designer</li> <li>• Boat narrator</li> <li>• Ghost tour designer</li> </ul>	<ul style="list-style-type: none"> <li>• Built environment (historic buildings, exhibits and memorial)</li> <li>• Natural environment</li> <li>• Geography (remote location)</li> <li>• Tour guide</li> <li>• Night-time</li> </ul>
Museum	Sydney	<ul style="list-style-type: none"> <li>• Museum manager</li> <li>• Youth visitor</li> <li>• Researcher</li> </ul>	<ul style="list-style-type: none"> <li>• Exhibit designer, workshop leader/ designer</li> </ul>	<ul style="list-style-type: none"> <li>• Exhibit (specimens)</li> <li>• Dissection activity</li> <li>• Built environment</li> </ul>
Sculpture Walk	NZ	<ul style="list-style-type: none"> <li>• Visitors</li> <li>• Artist/curator</li> <li>• Researcher</li> </ul>	<ul style="list-style-type: none"> <li>• Artists</li> <li>• Curators</li> </ul>	<ul style="list-style-type: none"> <li>• Art,</li> <li>• Natural environment (landscape)</li> <li>• Signage</li> </ul>

#### IMPLICATIONS OF THIS RESEARCH FOR PRACTITIONERS

With the introduction of social and emotional learning in Australian curriculums and OECD frameworks, research that accounts for the affective dimensions of learning spaces and their pedagogies is timely and relevant. The exemplar PhD research can be used to demonstrate the significance of learning space research that extends beyond psychological definitions of affect and dominant cognitivist and social constructivist understandings of pedagogy. Significantly it has the potential to show

how manipulation of learning spaces can create pedagogic affect and how pedagogic affect transforms learning spaces. In practical terms there are implications for the likes of galleries, museums, sports clubs, theatre arts, and historical sites.

By identifying the inherent value of heterogeneous learning spaces as sites of affective pedagogical encounters such research will provide advocacy for programs that fall outside established grammars of schooling and curriculum. This will lend recognition and legitimacy to the pedagogies of heterogeneous learning spaces, promoting the development of their unique pedagogic potential to the full, without unnecessarily forcing school-based practices upon them. The exemplar PhD research can achieve this by establishing the characterisations of the dimensions of affective learning and the conditions required for affective pedagogic contexts to effectively operate – informing future development of ‘scenes of pedagogical address.’ Not only will this foster a broader view of pedagogical vernaculars and their potential, but it will also pave the way for invigorated relationships between schools and broadly conceived spaces of learning.

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## BIOGRAPHIES



**Niamh Barry** is a Master of Education student at University College Dublin (2012–2014). Niamh has specialised in the area of learning spaces for the purpose of her thesis research. Barry is a secondary teacher of general Science, Biology and Physical Education for the past four years. Niamh graduated from Dublin City University (D.C.U) in November 2010 with First Class Honours Bachelor of Science degree in Biology and Physical Education with concurrent teacher education. She completed the additional five credits for recognition of her Extra-Curricular activities, receiving a Distinction in this module. Niamh was subsequently nominated for the D.C.U Chancellor’s Medal for the Class of 2010 in recognition of her outstanding academic achievement, alongside her contribution to the extra-curricular activities at the University.

**Chris Bradbeer** is an Associate Principal at Stonefields School in Auckland, opened in 2011. Being involved in developing a vision for teaching and learning, building teacher capacity in order to raise student achievement levels, and having the opportunity to consider ‘what might be possible’ has provided much of the impetus behind a research interest in learning environments. Chris’ interest is particularly focused on the opportunities engendered by the provision of new learning spaces, in particular the nature of collaborative teacher practice.



**Terry Byers** is currently the Director of Innovation in Learning at the Anglican Church Grammar School (Churchie) in Brisbane, Queensland. This role is focused on the effective integration of technology to best increase student’s engagement and academic outcomes. At this same time, he is uncovering ground breaking insights into the critical role that the classroom environment plays in this equation. This focus on empirical evidence has led to creation of the Churchie Personalised Learning Analytic program. Terry is currently a PhD candidate in the Australian Research Council project, ‘Evaluating 21st Century Learning Environments’. Recently, he was awarded the prestigious Australian Postgraduate Award and the 2014 Australian Microsoft Expert Educator.

## BIOGRAPHIES

**David Clarke** has worked at a senior level with some of Australia's leading national practices (Daryl Jackson Alastair Swain/Woods Bagot) before establishing Clarke Keller Architects. David has extensive experience over the last 20 + years in the design and management of the architectural process for commercial, institutional and multi-residential projects and has specific large-project management expertise. Through his collaborative working method, attention to detail, knowledge of construction processes and strong client focus, David has developed a reputation as an intuitive designer with a deep client understanding and a strong commitment to budget and programme management.



**Benjamin (Ben) Cleveland** is a Research Fellow at the University of Melbourne, where he coordinates the research program of the Learning Environments Applied Research Network (LEARN). His current academic activity includes Research Manager for the ARC Linkage Project 'Evaluating 21st Century Learning Environments', collaboratively teaching the Masters electives 'Innovative Spaces and Pedagogy' and 'Physical Learning Spaces: Effecting Pedagogic Change in Schools', and supervising a number of PhD and Masters research students in the field of learning environments research. He is also a Chief Investigator for the ARC Linkage Project 'Innovative Learning Environments + Teacher Change', which will run 2016–2018, and is leading a review of the Victoria Department of Education and Training's Standard Entitlement Frameworks (school design standards), as well as a three year program of learning environment evaluation for Catholic Education Melbourne.

Ben completed his PhD, 'Engaging spaces: innovative learning environments, pedagogies and student engagement in middle years of school' in 2011 and has published on the topic of school design in peer reviewed journals including Learning Environments Research; Pedagogy, Culture & Society; The International Journal of Learning; Critical & Creative Thinking; and Anatomical Sciences Education. He has also presented papers at numerous academic and industry-based conferences since 2008.

Ben is Chair of the Victorian Chapter of the Association for Learning Environments Australasia (formerly CEFPI) and Co-Chair of CEFPI's 2016 Australasia Region Conference, to be held in Melbourne.

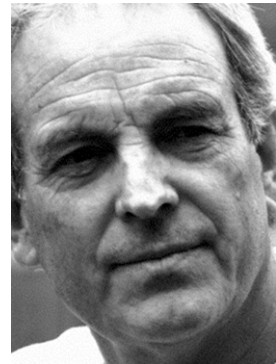
As an educational planner (consultant through Engaging Spaces), Ben has supported schools during both the design and occupation phases of 'space and

pedagogy projects'. Most recently he acted as the key educational planner for Learning Communities Victoria's successful bid to build 15 new schools in the state of Victoria through a Public Private Partnership (PPP) agreement.



**Jo Dane** is a designer, educator and researcher with a passion for educational transformation enabled through research-based design practice. She has been researching education theory and learning environments for over twelve years, with a particular interest in developing new space typologies for effective learning in higher education. As an academic and designer, Jo demonstrates an understanding of teaching and learning behaviours that integrally inform the design process. Jo works as an educational planner with global architectural firm, Woods Bagot, focusing exclusively on education projects.

**Kenn Fisher** is recognised internationally as one of the leading educational facility specialists. Throughout his thirty year career he has worked in a range of disciplines in all education sectors as a teacher and academic, a structural engineer, a strategic and campus planner, a project and facility manager and, more recently, as an educational researcher. Dr Fisher has served as the head of an OECD Program on Educational Building in Paris and was responsible for overseeing twelve activities related to educational building planning, design and management for 25 countries in all sectors of education. During this period, he controlled a program of educational building research and development involving 26 national ministries of education. He is a member of its successor's (CELE) international panel of experts.

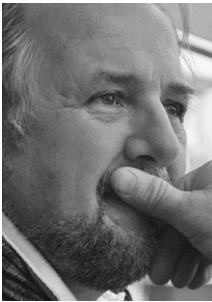


Now operating exclusively as a specialist in campus master-planning and educational facility strategic consulting and architectural briefing, Dr Fisher acts as the prime interface between designers, teachers and students to create environments for new teaching, learning and research trends. He has been engaged by more than 30 universities in Australia and overseas, numerous vocational training and community college clients, a number of state and national government ministries of education and many school organisations, and has directed numerous consulting and master planning studies. Dr Fisher has served as a campus master-planner for more than twenty institutions. He has also undertaken consulting for UNESCO in Laos and has been responsible for projects in Thailand, Cambodia, Indonesia, Malaysia, China, Hong Kong, New Zealand, the United Arab Emirates, the United States and Europe.



## BIOGRAPHIES

**Sarah Healy** is a current recipient of an Australian Postgraduate Award and is undertaking her PhD research investigating the pedagogies of affective learning environments at the Melbourne Graduate School of Education, The University of Melbourne. Sarah has a background in visual arts, the creative industries and education. She maintains an artistic practice and is a trained secondary school teacher. Her research interests include art education, affect, post-humanist research methodologies and learning environments.



**Wesley Imms** is an Associate Professor in the Melbourne Graduate School of Education where he is the Head of Visual Art and Design Education, that School's Research Higher Degree Coordinator for Curriculum and Teaching, and a member of the Learning Environments Applied Research Network (LEaRN). He has taught for many years across all educational sectors from Primary to Tertiary education, and has conducted significant research projects in schools across Australia and internationally. With over 70 research publications and experience working with teachers in schools through various consultancies, Dr

Imms has specialised in research concerning best educational practice, measuring learning outcomes, and optimising the impact of teachers in classrooms. In recent years his research has centred primarily on the effective design and use of learning facilities, with a focus on adapting pedagogies to optimise the spatial affordances of innovative learning environments. On this topic he is the Lead Chief Investigator on two category one Australian Research Council Linkage grants being run by LEaRN, which have drawn over 20 industry partners into developing an evidence base of 'what works' in classroom and school design. The Evaluating 21st Century Learning Environments ARC Linkage Project, being run from 2013 to 2016, focuses on the challenging issue of evaluation of these spaces, and has facilitated the development of this book. He also leads the Innovation Learning Environment and Teacher Change ARC Linkage Grant that extends evaluation theory into practical measures to improve the use of such spaces.

**Graeme Oliver** has an extensive background as a professional practitioner in 21st century learning environments. For a decade Graeme was one of the leadership team at the Australian Science and Mathematics School (ASMS). Graeme had particular responsibility for leading the development of coherent connections between the physical environment of the ASMS and the pedagogical approaches of the teachers and the learning experiences of the students. Graeme has extensive professional experience across the education system having been a member of the





Board of the South Australian Certificate of Education, and of the Board of the South Australian Secondary Principals Association. In 2013 Graeme received the John Laing Award (presented by Principals Australia Institute), and the Excellence in Teaching and School Leadership Award (presented by the Australian Institute for Teaching and School leadership).



**Lindy Osborne** Originally educated in South Africa, Lindy moved to Australia in 1996 where she commenced working as an architect, at Cox Rayner Architects in Brisbane. During her twelve years of practice, she received 14 industry awards in addition to her work being recognised in multiple printed media. A Senior Lecturer in Architecture at QUT, Lindy specialises in Design, Professional Practice and Technology. She was awarded a Vice Chancellor's Performance Award for Teaching Excellence, at the end of her first year as a full-time academic and an Australian Government Office of Learning and Teaching Citation, in 2012. Lindy's research interests centre around innovative

Design Education and the Design of Future Learning Landscapes: Linking Space, Place, Pedagogy, Technology + Context. Lindy is a member of the Design Learning Collective at QUT, a group of academics who are seeking to develop a research profile around design and architecture education.

**Mark Osborne** is a Senior Consultant who works in Future-Focused Education, particularly in the areas of Modern Learning Environments, Leadership and eLearning. To put it another way, he helps schools and centres build great spaces to learn while helping educators develop the capacity to make the most of those spaces. Mark also founded Emerging Leaders-Aotearoa, a group of several hundred educators who are committed to growing leadership capacity across the sector. Mark is currently completing his PhD on leadership in modern learning environments, at the University of Melbourne. Mark was part of the foundation leadership team that put together one of New Zealand's leading future-focused schools: Albany Senior High School. Mark also established the country's first open source high school, and an innovative bring-your-own-device (BYOD) programme in 2009. Mark has helped dozens of organisations launch their BYOD programmes, helping schools and centres to break free of industrial age education.





**Deirdre Raftery** has an international profile for scholarship and publishing, and supervises research in the history of education; gender and education; church-state relations; education ideas; digital humanities and education; and the history of women religious (nuns) and education. Her most recent book publications are (jointly) *Education, Identity and Women Religious, 1800–1950* (Routledge, 2015); *Educating Ireland: Schools and Society, 1700–2000* (IAP, 2014) and *History of Education: Themes and Perspectives* (Routledge, 2013). Raftery is an elected Fellow of the Royal Historical

Society (UK). She has recently won a Fulbright award, to conduct research in the USA in 2016, and holds a Visiting Fellowship at the University of Southampton, for 2015–2016. Deirdre is a life member at the University of Cambridge, and in 2010 held a Fellowship at the University of Oxford. From 2009–2014 Deirdre Raftery was joint editor of the international *History of Education*, and she currently serves on the Editorial Boards of *History of Education*, *History of Education and Children’s Literature*, and *Espacio, Tiempo y Educacion*.

**Leanne Rose-Munro** commenced her career as an educator and taught in many schools in metropolitan Melbourne and country Victoria. In 2008, Leanne diversified into Hearing Augmentation in the private sector before commencing Research at the University of Melbourne and founding the Learning Space Consultancy early 2012. Leanne specializes in Soundfield Technology and Hearing Augmentation solutions in the private sector. She has also been engaged as a sessional lecturer at the University of Melbourne Graduate School of Education – Post Graduate Teacher of the Deaf. Leanne is a member of the Council of Education Facility Planners International (CEFPI) and Learning Difficulties Australia. Leanne holds a Bachelor of Applied Science and Diploma of Education. She is currently completing a Masters by Research at the University of Melbourne.





**Ana Sala-Oviedo** is an architect, academic and Director of the educational planning consultancy, New Learning Environments | Rubida Research (NLE | RR). She is currently undertaking a PhD as part of the ARC Linkage Project, ‘Evaluating 21st Century Learning Environments’ at the University of Melbourne. Her focus is on the evaluation of learning environments to determine their effectiveness in supporting contemporary practice for the development of 21st century skills. Acting as a change agent Ana has used research and evidence-based design principles to link pedagogy and space. Her experience in both the architectural design of educational institutions and educational theory has helped her act as

the prime interface between designers, educators, students, members of the wider community and other key stakeholders to co-create learning environments for new and emerging teaching, learning and research paradigms.

**Philippa Soccio** is an architectural graduate and Research Fellow with the Learning Environments Applied Research Network (LEaRN) at The University of Melbourne. After completing her undergraduate studies in architecture, Pippa worked in architectural practice across the aged care, education and defence portfolios. In 2010–2014 Pippa completed her PhD at The University of Melbourne as a member of the Future Proofing Schools team; an interdisciplinary team exploring the design and use of prefabricated classrooms in Australia. As part of her PhD, Pippa developed a new post occupancy evaluation tool for identifying the causes of poor indoor environment quality (IEQ) inside learning spaces. Pippa and the LEaRN team intend to commercialise her tool in 2016 and undertake IEQ evaluations of learning spaces to build an IEQ database, which could inform future ‘comfort’ standards for schools. In addition to her research responsibilities, Pippa teaches Masters of Architecture students in the Melbourne School of Design.

