The Translational Design of Schools

An Evidence-Based Approach to Aligning Pedagogy and Learning Environments

Kenn Fisher (Ed.)

The Translational Design of Schools

ADVANCES IN LEARNING ENVIRONMENTS RESEARCH

Volume 7

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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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Edited by

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TABLE OF CONTENTS

v

TOM KVAN AND FIELD RICKARDS

FOREWORD

This edited book of selected chapters emerges from the work of the Learning Environments Applied Research Network (LEaRN) at the University of Melbourne. LEaRN is a multidisciplinary forum and international network bringing together academia and industry to research, imagine and discuss physical learning environments in school, vocational, university, medical and commercial academy contexts.

Contributions from scholars and post-doctoral researchers in this network showcase recent evidence-based evaluation of learning environments. The collection is organised around three important themes: emerging issues in learning environments; socio-cultural implications of learning environments; and place/space design implications for learning environments.

In exploring these three crucial themes these scholarly chapters dig deeper than the more commonly engaged surface or form related issues in design through an evidence-based approach to understanding the functionality of learning spaces that impact on the rather silent aspect of human environment experiences in learning in our educational and health buildings.

LEaRN is based on an understanding that the built environment critically impacts the educational experiences of teachers and learners and that applied research of innovative learning environments will bring benefit to a broad community of designers, users and policy makers. The research covers not only physical place but also the digital influences of what might be called virtual places. The studies extend, therefore, to consider the spatial implications of digital technologies on how, where and when people learn.

Instigated by the University of Melbourne in 2009, LEaRN is a network that links international expertise in physical learning environments; develops multidisciplinary partnerships; creates a bridge between industry and academia; maximises the impact of individual endeavours; respects intellectual ownership of new knowledge; informs governments, media and stakeholders as a peak body of expertise; and communicates cutting-edge research.

The network brings together business/industry, teaching, research, consultancy, policy/government and academia in a dynamic partnership. Partners contribute to setting innovative research agendas, the outcomes of which are shared across the network as research is developed for feedback, engagement and collaboration. Based on a model of partner contributions, LEaRN has won in excess of $4million

in research grants developed as targeted research programs with partner and government funding.

Members are part of a future-focused network exploring the design, education and health sectors, benefiting from links between professions, specialisms, academia and industry; engaging in idea-generating and collaborative discussions; having access to national and international best practice, at various stages of implementation; and guide, develop and access LEaRN publications, seminars, partner events and activities.

As an umbrella network of members representing broader communities, LEaRN benefits from the input and energy of its research partners. Our partner model allows us to react quickly when new research opportunities emerge.

LEaRN publishes regular research outcomes of which this book is an example.

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INTRODUCTION

This book provides an overview of the deep level of research informed and framed by the application of an evidence-based translational design (EBD) approach to the design of learning environments.

All of these chapters was directly associated (either as examined dissertation, supervision of doctoral candidate, affiliated member or Chief Investigator of an Australian Research Council funded grant) with the Learning Environments Applied Research Network (LEaRN) of the University of Melbourne and its partners and colleagues since 2009.

The ten chapters are based on – or have resulted from – ten 3–4 year full-time doctoral research dissertations with each chapter outlining the key findings and 'take-aways' from the respective dissertation or subsequent studies based on those dissertations.

As a narrative, the book ties together the chapters through the lens of evidence-based design (or EBD), itself originating from the Health Planning Sector. The rigour of that sector of course is based in the well-accepted methodology of Translational Research which has been used in Clinical Medicine for some years.

In adapting that practice the approach suggested by Norman (2014)[1] has been adopted, where Translational Medicine is akin to Translational Development which itself – when applied to other academic disciplines – is known as EBD Health Planning, Translational Engineering or – in the case of evidence-based architecture – Translational Design.

Thus the discipline of Educational Planning becomes the translational design of learning environments. In effect these doctoral dissertations are examples of this approach.

The chapters have been organised into a structure that examines evidence-based design through three key themes – emergent issues; socio-cultural implications; and place/space design implications. Each of the chapters is grounded in the literature and each posits a theoretical position which is tested in fieldwork, as is the norm in doctoral dissertations, followed by concluding remarks and avenues for further research. The literature, the theoretical position and the fieldwork data gathering and analysis are all integrated in the findings and conclusions towards an evidence-based outcome.

Part One explores emergent issues in learning environments and commences with the need to relate multiple (particularly spatial) literacies in pedagogical practice to

translational design. Thus, in chapter one, Kenn Fisher teases out the need for a more evidence-based approach to the design of learning environments to ensure that scaling up such spaces is carried out with minimal risk.

The second chapter explores how new generation learning environments might see a greater engagement of students in such innovative learning spaces. Here Ben Cleveland uses the measurement of student engagement in middle schools to test the effectiveness of such innovative spaces.

The third chapter explores space and place in classrooms through the varied lens of flexibility in a range of spheres. Ken Woodman explores teacher performance, curriculum innovation and spatial agility in classrooms and learning environments.

Part Two focusses on the socio-cultural implications of learning environments. The first chapter in this part sees Neda Abbasi exploring student identity formation in school contexts in looking at the whole school. This study examines internal identity formation and how this resonates with external social relationships across different school spaces and places.

In the fifth chapter Kate Bertram investigates the relationship between the physical environment and the learning culture of a school through an examination of the bigger picture of a design's functionality from different perspectives within schools. The way in which the design of physical space and the creation of a learning culture is negotiated and factors that influence the design of schools and the intricacies of how educational facilities influence learning cultures is also explored.

In the sixth chapter Kerry Bissaker interrogates learning environment affordances for effective professional development in an innovative senior secondary STEM (Science, Technology, Engineering and Mathematics) school. Here the focus is more on the teachers, although student behaviours in the new generation learning space – at the Australian Science and Mathematics School which opened in 2003 – are a significant measure of teacher performance in this study. Being an academic located close to the school on the Flinders University campus, Kerry was able to work closely in the field element of this study.

Chapter 7 sees Wes Imms examining how boys 'do' art and how they negotiate masculinities in the art curriculum. This process has significant spatial implications as boys tackle identity formation in this context.

Part Three considers place/space design and the implications for learning environments of the range of elements which have an impact on school design. In the first chapter on plans and pedagogies: school design as socio-spatial assemblage. Kenn Fisher and Kim Dovey have evaluated over 50 award winning school designs – with the award criteria premised around their pedagogical effectiveness – and have arrived at surprising conclusions. Some of the supposed new generation learning environments are perhaps more marketing plays than functioning practice as the learning environment layouts are interpreted through an urban design approach to spatial organisation.

The second chapter explores the design of primary school libraries through an inclusive and creative briefing and design process. Raylee Elliott Burns evaluates

the change in space in a technology-enabled primary years setting. Raylee has used her extensive years as a primary school teacher and librarian to interrogate the role of libraries in learning. As we move into a more online form of informal learning, libraries are set to take on a completely new meaning.

The final chapter, by Terry Byers (who, at the time of publication, was a nearly completed PhD candidate) and Wesley Imms, examines with a very focussed lens the concept of new generation learning spaces (NGLS). They note that what has been remiss has been an evaluation of the impact of these spaces, particularly in terms of student engagement, improving pedagogy, and improvements in teacher use of ICT. This study utilised a mixed-methods design (single subject repeated measures, and qualitative analysis) to explore these issues in a middle-school setting. Staff and students rotated between three 'modes' of classrooms each term for one academic year.

Perhaps the most significant conclusion that can be drawn from this set of studies is that there is a pressing need for evidence to be produced to illustrate what works in new generation learning environments, and why.

This evidence is largely absent while Ministries of Education, independent and other schools systems the world over continue to invest significant sums in new generation – and indeed old generation – learning spaces, with little evidence to underpin the decisions being taken. More such studies are required.

Indeed we need evidence to place in front of 'classroom' teachers so that they will be convinced that the industrial age egg crate 'bells and cells' model of learning environments is well and truly outdated.

It is only when we can use robust, replicable, scholarly evidence to convince teachers to change their pedagogical practice so that students will have better learning outcomes that we will see a more learner centred NGLS model. And with that learner centred-ness comes a much more agile, adaptive, organic and multi-layered cluster of learning spaces that students can select from to suit their learning needs.

NOTE

[1]   Norman, D. (2010). *The research-practice gap*. Retrieved December 20, 2014, from http://www.jnd.org/dn.mss/talk_research_ practice_gap_2_kinds_of_innovation_1.html

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CHAPTER ABSTRACTS

PART 1: EMERGENT ISSUES IN LEARNING ENVIRONMENTS

Chapter 1. The Translational Design of Learning Environments (Kenn Fisher)

Whilst there is a limited emerging field using evidence-based design (EBD) to shape our new generation learning environments, this chapter takes issue with the lack of scholarly rigour and depth of that EBD research. There is a massive amount of research underway in education generally but there is little in space and place that can be effectively accepted as evidence-based approaches which can be adapted and adopted in practice.

Yet health planning and design practice – which has been extant for close to twenty years – has a significant depth of rigour which is based on, or adapted from, a long tradition of translational medicine. This chapter suggests that a similar approach should be applied to educational planning practice, and cites a number of examples that illustrate how this may work.

Chapter 2. Addressing the Spatial to Catalyse Socio-Pedagogical Reform in Middle Years Education (Benjamin Cleveland)

This paper describes an interdisciplinary PhD study that explored the relationships between physical learning environments, constructivist pedagogies and student engagement. The study was undertaken as part of an Australian Research Council Linkage project entitled *Smart Green Schools* and was conducted in Melbourne, Australia.

In the pursuit of new knowledge about how architecturally designed spaces could better support learner-centered education models, the study investigated spatial and pedagogical change in the middle years of schooling (Years 5–9). It revealed that carefully considered and innovatively designed learning spaces could catalyse the adoption of constructivist pedagogies and encourage higher levels of student engagement.

In keeping with these findings, the paper introduces two new constructs that were found at the intersection of space and learning: 'reflexive learning environments' and 'student geographical engagement'.

Chapter 3. Re-Placing Flexibility: Flexibility in Learning Spaces and Learning (Ken Woodman)

Pedagogy has been moving from a teacher-centred, didactic and instructionist model to a student-centred, personalised and constructivist approach. As a result, classrooms

are changing from rectangular, enclosed, repetitive cells to open, connected, flexible learning spaces.

This chapter is based on a PhD thesis completed within the Smart Green Schools research project at the University of Melbourne supported by an Australian Research Council Linkage Grant. The thesis research question asked: "How does flexibility in learning spaces affect learning?" This study explored the phenomenon of flexibility through theories of constructivism, movement, space, place and environmental psychology.

The qualitative, multi-method case study was based on a secondary school in regional Victoria, Australia. Findings led to discussions on meanings, practice, transformability, fluidity, de-territorialisation, place making, student freedom, and heutagogy. This study re-placed flexibility as a process of learning rather than a product of building.[1]

PART 2. THE SOCIO-CULTURAL IMPLICATIONS OF LEARNING ENVIRONMENTS

Chapter 4. Adolescent Identity Formation and the School Environment
(Neda Abbasi)

The chapter presents an interpretation of identity formation during adolescence that informs the development of school environments which are responsive to adolescents' developmental needs. A review of literature on adolescent identity formation and schooling for identity development was conducted to set the grounds for further exploration of design-related implications of adolescent identity formation for schools' physical environments. The chapter opens with a review of some definitions and theories of identity formation and crucial factors and experiences involved in this developmental task of adolescence. Implications of the processes of identity formation for education of adolescents are then explored. Analysing and synthesising the outcomes of the two strands of literature review, two key characteristics of schools that support adolescent identity formation are identified and associated factors and issues elaborated. Three major processes involved in adolescent identity formation are identified: (1) separation or individuation process; (2) social integration or relational connectedness; and (3) developmental exploration. Schools that contribute to these identity formation processes are suggested to have two characteristics: (1) they have a supportive school environment addressing adolescents' needs for individuation and social integration; and (2) they offer opportunities to adolescents for developmental exploration. The chapter continues with examining implications of these characteristics for physical spaces of schools through a review of research and practices of learning space design. Four secondary schools in Australia which represented an innovative approach to learning space design are considered as case studies to provide insights into the design-related implications of adolescent identity formation and better

understand issues and challenges associated with them. The chapter concludes with proposing five design principles which supports adolescent identity development through contributing to processes involved in identity formation: (1) downsizing schools or adopting design strategies to support the idea of smallness; (2) creating social spaces; (3) maximising flexibility; (4) addressing considerations for design and arrangement of furniture; and (5) promoting transparency and visual connections.

Chapter 5. The Cultural Architecture of Schools: A Study of the Relationship between School Design, the Learning Environment and Learning Communities in New Schools (Kate Bertram)

This chapter investigates the relationship between the physical environment and the learning culture of a school through an examination of the bigger picture of a design's functionality from different perspectives within schools. The way in which the design of physical space and the creation of a learning culture is negotiated and factors that influence the design of schools and the intricacies of how educational facilities influence learning cultures is also explored. Further, this research considered the influence of leadership on the creation of effective learning environments.

A multiple case study approach was used with three K-12 schools from the New South Wales non-government sector. Data was collected through a number of methods, including surveys, interviews, photographs and observations. The data was systematically analysed using a constant comparative method. The findings of the study were compared to the current literature on learning communities, leading to a framework for articulating the relationship between the built environment and learning community cultures.

The study identified the importance of school context and key influences on learning environments, especially the impact of constraints, masterplanning and affordability. A number of factors that contributed to building effective learning environments were identified, and these factors were: information technology resources; space; flexibility; control and physical comfort. The research also highlighted collaborative styles of leadership and the centrality of the school principal to the design process.

Also investigated was the relationship between the physical environment and the learning culture of a school through an examination of the bigger picture of a design's functionality from different perspectives within schools. Each case study school was considered as a complete entity, where a community of learners functioned within a specific physical space and environment.

The study explored the way in which the design of physical space and the creation of a learning culture is negotiated, including factors that influence the design of schools and the intricacies of how educational facilities influence learning cultures. This research also considered the influence of leadership on the creation of effective learning environments.

Chapter 6. Aligning Learning Environment Affordances for Effective Professional Learning in an Innovative Senior Secondary STEM School (Kerry Bissaker)

This study reports on the outcomes of longitudinal research on teachers' professional learning in an innovative senior secondary school, the Australian Science and Mathematics School. The purpose-built school was conceived and designed as a collaborative endeavour between the South Australian Department of Education and Children's Services and Flinders University as a response to declining enrolments in science and mathematics courses in secondary schools and universities. The school was located on Flinders University's campus and opened in 2004. Teachers' learning was identified as a priority in achieving the school's vision of innovation and reform in the teaching and learning of science and mathematics. The research, a qualitative interpretive case study, was conducted over a period of six years and grounded theory methods were used to answer research questions about what supported and sustained teachers' learning in this innovative context and the subsequent outcomes for teachers, students and the school as a learning organisation. Alignment between teachers' learning needs and these environments were viewed as affordances and reported by teachers as being significant to their learning. Affordances were contextual, organisational and relational and all supported teachers to learn in intentional and incidental ways. However, the flexibility of the learning spaces generated by the building's design and functionality served as a foundation for the creation of highly collaborative and interactive teacher learning and engagement which in turn generated innovative interdisciplinary curriculum and reformed teaching and learning in the school.

To achieve an authentic account of the teachers' lived experiences the author positioned herself as an insider-researcher working intensely and thoughtfully with staff at the ASMS. The analysis and interpretation of a range of data collected over an extended period of time supported the development an in depth understanding of the interactions between contextual conditions, organisational elements and relationships factors that provided a context for and enabled teachers' professional learning.

An explanatory model of professional learning was developed as an outcome of the theorising process and identified the importance of alignments between teachers' capacities, characteristics and sense of personal agency. Successful alignments were identified as affordances[2] for teachers' learning and formed the basis of the explanatory model. In essence, the contextual conditions, organisational elements and relationship factors of the ASMS provided the architecture of the explanatory model of professional learning and the teachers acted as explorers of the architecture.

The research determined that teachers brought existing beliefs and practices to the ASMS but through incidental and intentional learning these beliefs and practices were expanded and often changed. Teachers developed deep understanding of many factors associated with effective pedagogy including learning and learning processes, new science and mathematics content, effective curriculum design and authentic assessment processes. They were open to challenges and recognised their roles as learners in

achieving the vision of the school. There were varied outcomes for different teachers but the outcomes had an influence on students and the school as a learning organisation.

There was much evidence that the investment in teachers as learners was pivotal to achieving the vision of transforming science and mathematics education in the senior secondary years at this school.

Chapter 7. Occupying Curriculum as Space (Wesley Imms)

Learning environment research is gaining previously unachieved sophistication as it develops beyond 'post occupancy evaluation' towards socio-cultural examinations of how students and teachers occupy and utilise space. This chapter argues that knowledge gained though previous research can be 'mined' for such spatial implications. The overlap between gender studies and curriculum is one such field.

Curriculum remains an effective tool for implementing macro-policies of government and articulating wider socio-cultural agendas in schools. However, for all this success there exists a very limited understanding of its lived impact on the student – that is, how curriculum is actually inhabited by an individual. A doctoral study was conducted in the late 1990s to address this paucity of knowledge. When published, the study advanced thinking on this topic, but now is open to further examination. The purpose of this chapter is not to repeat what was found, rather to re-interpret its findings *through a spatial lens*.

Time is a great teacher; academic activity by the PhD's author in the intervening eleven years, particularly in the area of learning environments research, has allowed a different perspective on how curriculum is actually occupied and manipulated by its inhabitants.

PART 3. EVALUATING LEARNING PLACE/SPACE DESIGN AND IMPLICATIONS FOR FUTURE DESIGN

Chapter 8. Plans and Pedagogies: School Design as Socio-Spatial Assemblage (Kenn Fisher and Kim Dovey)

This paper explores the contemporary transformation of school classroom clusters in response to changing pedagogies. This conversion is typically described as that from the enclosed classroom to towards the 'open' plan with the emergence of new spaces (learning streets, meeting, commons, outdoor learning, retreat) and new interconnections and flexibilities between them.

With a focus on middle-schools, this paper critically interrogates the concepts of 'openness' and 'flexibility' to construct a typology of emergent spatial configurations. Learning clusters from a range of recent and award-winning school plans are critically analysed as socio-spatial assemblages. The emergent architecture embodies a very broad range of plans but also exhibits certain patterns of spatial structure and segmentarity designed to enable new forms of teaching and learning.

Five primary plan types are identified, ranging through various degrees of convertibility from the traditional classroom to permanently open plans. If traditional classrooms with their corridors and doors can be well explained in terms of Foucaultian disciplinary technology, the more open plans suggest a use of Deleuzian assemblage theory to analyse learning clusters as forms of socio-spatial assemblage that mediate practices of power and empowerment in new ways. Most emerging types are designed to enable both new and traditional pedagogies embodying a tension between conflicting desires for discipline and autonomous learning.

Chapter 9. Voices of Experience: Opportunities to Influence Creatively the Designing of School Libraries (Raylee Elliott Burns)

This chapter connects the possibilities offered by evidence-based approaches to the designing of educational spaces with dimensions of the critical ethnographic study, 'Voices of experience: opportunities to influence creatively the designing of school libraries' (Elliott Burns, 2011). The doctoral study investigated the participative potential and possible processes for multiple *voices of experience*, of educators, designers/architects, education facility planners and students/learners, to influence the designing of spaces for learning and teaching using school libraries in Queensland, Australia as example spaces.

The chapter summarises the key motivations, concepts, informing theories, methodologies and contexts of the study. An overview of the *small stories* of study participants illustrates the challenges and the potential for creative possibility and creative influence. In keeping with the focus of this book the discussion presents noteworthy themes and findings arising in the *voices of experience* research. The discussion identifies current and extended prospects for creative influence by participants in learning space designing with respect to evidence-based designing approaches.

Chapter 10. Evaluating the Change in Space in a Technology-Enabled Primary Years Setting (Terry Byers and Wesley Imms)

New generation learning spaces (NGLS), often characterised by multi-use spaces and the innovative use of furniture and information computer technology (ICT), now exist in all Australian educational sectors. What has been remiss has been evaluation of the impact of these spaces, particularly in terms of student engagement, improving pedagogy, and improvements in teacher use of ICT.

This study utilised a mixed-methods design (single subject repeated measures, and qualitative analysis) to explore these issues in a middle-school setting. Staff and students rotated between three 'modes' of classrooms each term for one academic year.

Repeated online surveys (students and staff) and interviews (staff) gathered data used to judge five measures implicit to changes in pedagogy, three measures relevant to teacher use of ICT, and six measures indicative of student engagement. Separate

analysis (t-tests) of summative assessment of mathematics curriculum provided additional analysis concerning student learning outcomes in the three types of rooms.

Results from surveys and interviews indicated significant difference in three of the student engagement measures, two of the pedagogy measures, and three of the ICT use measures, suggesting that types of rooms and ICT impacts these educative domains. This research, with a sample size (n = 50) and high retention rate (greater than 95%), provides evidence that space does matter, both in terms of student and teacher enjoyment of teaching and learning but importantly also in terms of positive educational outcomes.

Classroom design can positively impact student engagement, teacher use of ICT, and teacher and student perceptions of 'good teaching'. Implications for further research include the suggestion that students 'inhabit' rather than 'occupy' learning spaces, in that they actively seek ways to make classrooms suit individual learning styles and interests.

NOTES

1 The colour plates in this chapter are only available in the e-book version.
2 An affordance is generated when environmental conditions enable the actors using the environment to achieve a desired goal.

PART 1

EMERGENT ISSUES IN LEARNING ENVIRONMENTS

KENN FISHER

1. THE TRANSLATIONAL DESIGN OF LEARNING ENVIRONMENTS

EVIDENCE-BASED DESIGN PRACTICE

The transformation of design thinking through evidence-based design in health facilities planning is based on the medical model of clinical research. These studies ensure that the resultant evidence is sufficiently valid, replicable and double blinded to ensure the safety of a procedure under test for ultimate commercial use with patients.

Also known as translational (clinical) research, the method has been adopted and adapted by health facility planners with qualitative and quantitative studies measuring, for example, the rate of healing of patients in different physical environments and in varying therapeutic regimes. The use of a scholarly evaluation rigour drawn from such methodologies and applied in developing new clinical procedures results in convincing evidence of the impact of the physical environment on human behaviour (Ulrich et al., 2004). Such an evidence-based approach is becoming essential in learning space design as the early 21stC sees the rapid emergence of wireless broadband and mobile communications devices that are inexorably changing the way people communicate, collaborate, create and transfer knowledge.

The vast majority of our learning environments were designed in the 19th and 20th centuries. Now, in the 21stC, new learning environments are being reengineered to meet these new and emerging technologies. They are also being designed to support new knowledge production, learning and work practices. However, these developments have not been thoroughly evaluated to assess if they actually work and whether should be scaled-up widely across school systems.

THE ORIGINS OF TRANSLATIONAL RESEARCH

Derived from medicinal sciences, and formerly known as clinical and medical science, translational research (ANU, 2009) can be defined as follows:

> To improve human health, scientific discoveries must be translated into practical applications. Such discoveries typically begin at 'the bench' with basic research in which scientists study disease at a molecular or cellular level then progress to the clinical level, or the patient's 'bedside'. Scientists are increasingly aware that this bench-to-bedside approach to translational research is really a two-way street. Basic scientists provide clinicians with new tools for use with

patients and for assessment of their impact, and clinical researchers make novel observations about the nature and progression of diseases that often stimulate basic investigations. Translational research has proven to be a powerful process that drives the clinical research engine. (NIH, n.d.)

There is an emerging trend to leverage what is becoming known as 'transactional knowledge' into the knowledge partnership domain, refer Figure 1. This is evident at the Australian National University (ANU, n.d.) and also at North-Western University (Norman, 2010). In the latter, alternative terms have been explored such as 'translational science' and 'translational engineering' due the 'gap' between research and practice.

Research is research, and practice is practice, and never the twain shall meet,… The gap between these two communities is real and frustrating. (Norman, 2010)

In some cases it is argued that this gap is deliberate, where, on the one hand, researchers traditionally find it 'uninteresting' to commercialise intellectual property whilst conversely many practitioners are not interested in research findings.
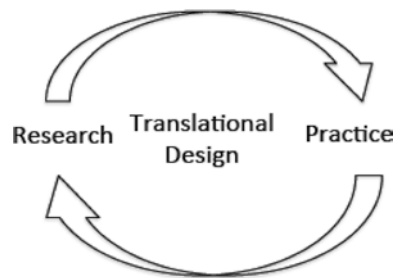
Figure 1. The inter-relationship between research and practice

Further many practitioners say that the research is not applied enough and not useful in practice. Norman also argues that sometimes the gap is a result of misunderstandings on both sides around goals and requirements. Some researchers believe their ideas are not applied correctly whilst some practitioners argue that the research results cannot be readily translated into workable applications.

Norman specifically critiques the discipline of design, arguing that 'design is still an art, taught by apprenticeship, with many myths and strong beliefs, but incredibly little evidence. We do not know the best way to design something. The real problem is that we believe we do. Beliefs are based more on faith than on data' (op. cit.). Indeed he argues that the evidence, such as it is, is based on so-called 'best practice' and that there has been no rigorous analysis of practice, in part because it is so difficult to control or fix a wide range of variables in practice.

In urging that similar methodologies should be used in the architectural profession, he urges a 'use-inspired' basic form of research, such as Pasteur used in

developing antibiotics, as illustrated in Figure 2. In this context a problem is isolated and research carried out to solve the problem. Whereas Thomas Edison (Figure 2) was more interested in using relevant knowledge to solve an applied problem, he was less concerned with trying to extend the general understanding of phenomena of the material that would improve the already existing light bulb.

Thus, according to Norman, he did not advance our understanding of science or engineering significantly. Edison was more 'consumed with making sure his inventions were practical and useful'. Norman suggests that Edison may have read the scientific literature but didn't add to it.

A third quadrant is inhabited with what Norman calls 'tinkerers' who produce inventions that neither adds to fundamental understanding nor have any use. The fourth and most significant quadrant is reflected by Pasteur, which does not resonate with the interest of the pure scientist as is illustrated by Bohr in the remaining quadrant.

Use-inspired researchers are interested in a quest for fundamental knowledge within a specific use context where the biggest payoffs lie, for example, with a smallpox vaccine. Pasteur started with a real, practical problem and understood that fundamental scientific insights were needed before it could be solved. He then 'did the science and then applied it back to the problem'.
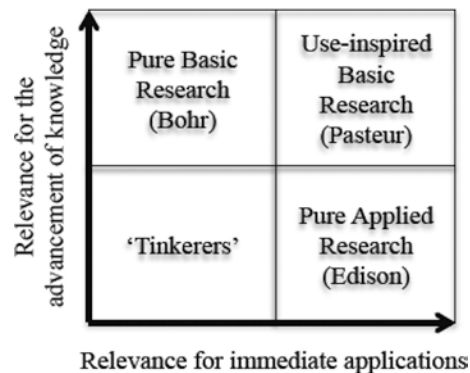
Figure 2. The research relevance dilemma
Source: openeducationresearch.org

Such research is done in search of solutions to real problems, or what Stokes (1997) calls 'use-inspired basic research'. However, Normal suggests yet another model, that of translational development:

Between research and practice a new, third discipline must be inserted, one that can translate between the abstractions of research and the practicalities of practice. We need a discipline of *translational development*. Medicine, biology, and the health sciences have been the first to recognise the need for

this intermediary step through the funding and development of centres for translational science. This intermediate field is needed in all arenas of research. It is of special importance to our community. We need translational developers who can act as the intermediary, translating research findings into the language of practical development and business while also translating the needs of business into issues that researchers can address. Notice that the need for translation goes in both directions: from research to practice and from practice to research. (Norman, 2010, op. cit.)

In stating that there is a huge gap between research and practice Norman argues that we need a new typology of practitioner known as *the translational developer*. They can work between the two 'sides' and understand the insights of researchers and translate them to practical outcomes. Conversely, they can translate the problems and concerns of practice into the clear, need-based statements that can drive researchers to develop new insights.

Such a model requires the transfer of intellectual property between researchers and practitioners and vice-versa. Researchers and companies could take a 'bench to bed' or 'lab to leader' approach in expanding the knowledge partnerships (University of Melbourne, 2014) model.

RECIPROCAL KNOWLEDGE TRANSFER

To a certain extent, knowledge transfer already occurs in many research and corporate institutions, but it might be focused even more using some of the concepts embedded in translational research. Alternative concepts could be considered in disciplines other than medicine such as, for example, translational engineering, translational science or translational design in architecture,

The University of Melbourne has adopted a knowledge transfer model although it acknowledges that this term could be construed as 'one way traffic' and prefers the term knowledge partnerships (University of Melbourne, 2014b) thus overcoming a weakness identified in Norman's analysis – it is two-way traffic, not just one-way. A taskforce on knowledge transfer observed that the university could be viewed as an 'arrogant institution' if knowledge was just one-way. The task force also noted that knowledge exchange – as a two-way process – is a narrower term than the process of community engagement that forms the third strand of the triple helix (research, application and community).

Knowledge transfer supports knowledge partnerships by 'advancing knowledge through the sharing of information and skills between the University and its external partners; is mutually beneficial to the University and its external partner; links into the University's teaching, learning and research; prepares students to be global citizens; increases the participation of economically disadvantaged students and contributes to the social, economic, environmental and cultural life of the wider community' (University of Melbourne, 2012).

Activities within knowledge transfer can range from partnerships with external organisations, the commercial development of research and appearances in the media and at public forums. It is intrinsically connected to research and teaching and can be a component of both. When teaching and learning activities include the input or involvement of an external partner or collaborator then they contain an element of knowledge transfer and this will involve a mutual exchange of intellectual knowledge. For example, many courses in architecture have visiting lecturers from industry, as do business and commerce. We also know that the teaching of medicine has for centuries relied on clinical practitioners to teach doctors their profession in teaching hospitals.

Student engagement with industry may include subjects and projects which involve external partners volunteering in training seminars, workshops and volunteer service research opportunities that offer engagement with business, government and community organisations internships. I now turn to how these concepts can be applied to the design of knowledge environments.

HYBRID KNOWLEDGE ENVIRONMENTS

21stC blended and hybrid knowledge models – simultaneous online and face-to-face – seriously call into question the efficacy of the still pervasive industrial-age classroom-based models of knowledge construction. The following explores learning environments, health environments and workplace environments – arguably all coming under the rubric of knowledge environments.

During a Queensland University of Technology Workshop in 2005 in conjunction with this writer, William Mitchell (see Figure 3) noted that we now have a true synchronous /asynchronous and virtual/physical matrix of knowledge opportunities for which our existing local/synchronous knowledge environment infrastructure is not well suited.

	synchronous	asynchronous
local	face-to-face meeting places	site specific signage exhibitions installations white board
remote	telephone video conference text messages shared cyber links	internet web virtual studio 'google it'

Figure 3. The physical virtual matrix
Source: Mitchell (2005)

As a response to these developments, many innovative knowledge environments are being tested. This includes an increasing focus on so-called 'third-spaces' to

support social forms of interaction. We therefore need to rethink the nature of a 21stC learning environment. These developments are blurring the boundaries between what has traditionally been seen as the built learning environment and the associated information and communications technologies that inhabit those spaces.

Three environments are explored below to illustrate how translational design can influence the relationship between the virtual and the physical in practical applications – these are the *healing environment*; the *office workplace*; and the *learning environment*.

HEALING ENVIRONMENTS

A large and growing body of evidence supports the notion that the physical environment impacts patient stress, patient and staff safety, staff effectiveness and the quality of care provided in healthcare environments. As a consequence evidence-based design is increasingly being used to guide health environment planning and to inform design decisions to improve patient, staff and health care outcomes.

Evidence based design is a process for applying research findings about the physical environment to improving the design (The Nurture Report, 2007, p. 1). Links between the natural world and healing through *quantitative* data collection has steadily grown, for example a view through a window may influence recovery from surgery (Ulrich, 2008). Ulrich's work has since guided the study of links between physical and architectural characteristics with human wellbeing through the 'common denominator' of stress reduction (Malkin, 2008, p. 26). Evidence-based design follows an 8-step process (Figure 4):

- Define evidence-based goals and objectives.
- Find sources for relevant evidence.
- Critically interpret relevant evidence.
- Create and innovate evidence-based design concepts.
- Develop a hypothesis.
- Collect baseline performance measures.
- Monitor implementation of design and construction.
- Measure post-occupancy performance results.

Research methodologies vary from casual observation through systematic observation and cognitive interviews to focus groups and surveys (Picker Institute, 1999). The activity of interviews and focus groups has to be carefully managed and in some cases can be combined into one category called 'focused interviews' which may be individual and group. They are flexible, appropriate for various populations, and provide first-hand patient insight (Cama, 2009).

Systematic observation requires monitoring environments and subjects in an environment while recording similarities or dissimilarities (Zeisel, 2006). Although this method might be cost-effective and relatively unobtrusive, such observations
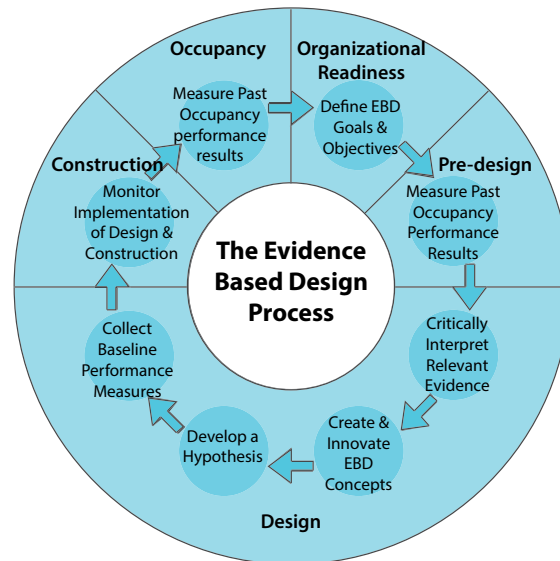
Figure 4. The evidence-based design process
Source: www.healthdesign.org/chd

may permit human error, as it is open to misinterpretation. The resulting observational data is more detailed while less generalisable (Cama, 2009).

Depending on the analysis, interviews afford both *quantitative and qualitative* data; conversely, they are time-consuming intensive and make comparison and generalisation difficult (Cama, 2009). Surveys (including questionnaires) allow easy comparison of specific data and offer control and efficiency of collection of data (Zeisel, 2006). However they are inappropriate for answering complex issues and are highly intrusive (Cama, 2006; Zeisel, 2006).

Possible performance measures fall into a number of categories including a) *overall organisational performance* – financial and economic measures (including average cost per patient day); clinical measures (including average length of stay [ALOS], stress measures, medication errors, nosocomial infection rate, fall rate, and mortality); satisfaction measures (including patient satisfaction, family satisfaction, staff satisfaction, physician satisfaction, market share, and community perception); b) *social and cultural interventions* – environment supportive of family and social connections; environment supportive of the staff; philosophy of organisational culture; c) *commitment to safety* – aspects of patient safety; safety for the staff; continuous improvement model.

Other factors include d) *healing environments* – stress reduction; access to nature; attention to the senses; wayfinding; positive distractions; e) *performance improvement* – efficiency; systems initiatives; f) *technology usage/leverage* – medical

technologies; computer technologies; labour-saving technologies; and g) *sustainable design* – greenstar; materials selection; water conservation and site planning. Effectively understanding and applying this range of performance measures, and using them to evaluate the performance of the facility, is becoming increasingly complex. As now occurs for Greenstar Professionals, health professionals – at least in the United States – can choose to become certified evidence-based health planners through EDAC (EDAC, nd.).

Accordingly, the Centre for Health Design's internationally recognized EDAC program awards credentials to individuals who demonstrate a thorough understanding of how to apply an evidence-based process to the design and development of healthcare settings, including measuring and reporting results. Its mission is to develop a community of *certified industry professionals* through education and assessment of an evidence-based design process.

Its vision is that all healthcare environments are created using an evidence-based design (EBD) process. EBD bases decisions about the built environment on *credible research* to achieve the best possible outcomes. Effectively, the fully accredited evidence-based practitioner could be seen as a translational developer or designer as they have achieved the highest level of research impact, which includes doctoral study and/or academic journal peer-reviewed articles outlining their evidence.

Evidence-based design was most recently endorsed in the design profession with the St Vincent's O'Brien Centre. This is a centre for adolescent patients suffering mental health problems and it is designed to remove the stigma from such diagnoses. From an evidence based perspective, Huffcutt (2010) has suggested that incorporating holistic healing programs should consider the impact of the physical environment on the mental, emotional, and physical states of patients. He notes that understanding how the physical environmental affects patients undergoing psychological rehabilitation has been 'less studied'.

In the mid-1800's Kirkbridge (1984) argued that the design of psychiatric facilities should incorporate a cheerful and comfortable appearance while discarding 'everything repulsive and prisonlike' (Kirkbridge, 1984, p. 624). However, the latter authors suggest that it is not possible to determine what the impact of the environment might be in the treatment of patients 'nor what good effects may result' (op. cit.). Subsequently guidelines have been developed to improve the lot of psychiatric patients.

Such guides suggest that all behavioural health facilities and units should be designed to appear 'comfortable, attractive…and [avoiding] an institutional look' (Sine & Hunt, 2010, p. 8). They further state that adolescence 'is a difficult developmental period of rapid physical, mental, and emotional change which complicates the recognition of mental illness in adolescents'.

Not surprisingly there are links between health and education with linkages for advancing appropriate mental health partnerships with schools (LAAMPS, 2014). The literature on adolescent mental health suggests that changes in identity,

biological development, and peer interaction may result in behaviours that generate mistrust by adults (Willis, 1992).

Further, 'adults generally dislike and mistrust adolescents more than any other age group' (Rice, 1992, p. 3). Other findings include the need for privacy (see Figure 8), access to nature, choice and control, and social support. Issues of control can be addressed through access to communication and opportunities for privacy. Other aspects to consider include spaces for social support from visitors and peers and 'positive distractions' such as entertainment and art. Views to nature promote visual connections to the outside world whilst community grounding and promoting rehabilitation into society are also considered essential.

From a practitioner viewpoint adolescent mental health facilities need opportunities for individual 'calm down' spaces relating to adolescent needs for privacy and the inclusion of murals drawn to a realistic, detailed imagery. It has been found that murals and artwork offer opportunity for mental escape and are a source of positive distraction (Hathorn & Nanda, 2008). Cool colours, such as varying hues of blue and purple, are preferred and numerous studies and articles have found an association of cool colours (green, purple, and blue) to feelings of calm (Figure 8) and relaxation suggesting residents' needs for calming spaces. Residents disliked imagery with strong primary colours, child's toys, and small-scale furniture whilst there is a strong desire for natural lighting.

Many of these concepts were designed into Sydney's St Vincent O'Brien's Adolescent Medical Health Centre. St Vincent's is focused on helping to prevent mentally ill youth being admitted to adult facilities. It is intended that this facility will massively improve the level of care for younger patients between the ages of 16 to 30, as it allows for a far more caring environment to heal and repair the young people's minds. The facilities also aim to provide much more support for the families.

Recently awarded the first prize in an international health facilities design competition the jury stated that the design integrates vibrant colours and a flowing layout creating a true sense of community. The 'evocative interiors' and the 'warmth

Figures 5 and 6. The O'Brien centre
Source: Woods Bagot

of colour and texture to the interior spaces' is an excellent example of patient-based design.

The jurors noted that a small project was picked this year (2012) as 'the true test in the healthcare sector is not only based on efficiency but on the personal experience of the patient', so the winning design had to design its rooms to be 'not only based on the patient but the patient's family'.

It also noted that the crucial healthcare challenges lay in the fact that each scheme requires hugely varying complexity to resolve its programmatic needs. For example, a small clinic does not require much complexity in its layout but may be a stunning piece of architecture. In contrast to this large, multi-purpose hospitals will show highly resolved, extremely complex floor plan layouts but sitting within uninspiring architecture.
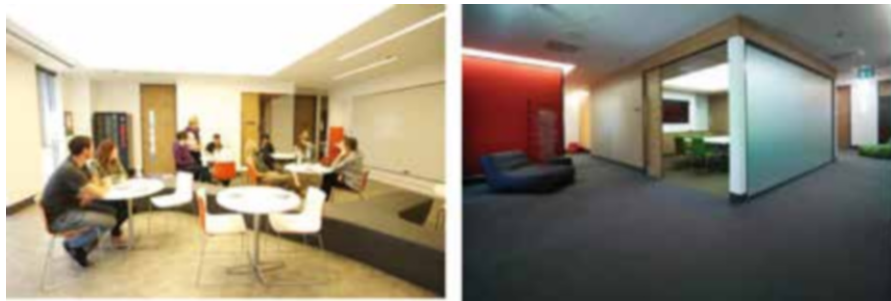
Figures 7 and 8. The O'Brien centre
Source: Woods Bagot

The jury also noted that great thought was put into creating flexible, well-lit spaces that create a sense of community and encouraging a social aspect to the healing process is essential (Figure 7). In this project the jury commented that the designers exceeded brief in terms of the level of detail applied, to the level of designing window seating that encourages the patient to sit there (Figures 5 & 6) and the integration of natural light and nature as a key way to alleviate stress.

Mental health facilities in the past – as noted above – have been very clinical and restrained which the jury notes share similarities to prisons, whereas 'this design is a world apart'. Redefining how we see mental health within society, embracing it and creating a comfortable rather than imposing environment for the patients to live in is fundamental to a successful health outcome.

The role of the translational designer in such a process is critical so that evidence is brought to bear on the design process, rather than designing blind or on instinct.

THE OFFICE WORKPLACE

Translational design and evidence-based design is more difficult to establish in this domain as there has been little peer reviewed academic research on the topic.

Whilst there are a number of qualitative academic journal articles that consider issues around power relations in the workplace, there had been little peer reviewed quantitative evaluation work done using rigorous research methods.

Consultants in this field present many planning and design tools but these are usually kept internally within those consulting agencies as a means of maintaining a competitive advantage. Thus it is hard to point to translational developers or designers in the field of workspace design.

Useful writers in the qualitative domain however do include Fayer and Weeks (2007) who explore proximity, privacy and permission both within the virtual and physical thirdspace; Matthew et al. (2011) covering the evaluation of open plan offices, change and organisational management; Humphrey (2011) and Berger (2004) looking at personalising, nesting, the virtual/physical nexus, and the apparent failure of the hoteling concept; Bennet, Pitt, and Owers (2008) on social networking in offices; Baldry and Barnes (2009) critiquing the open-plan academy and the issues of space, control and the undermining of professional identity; Pinder et al. (2009) putting the case for a new academic workspace; and Nenonen (2004) who explores the intangible benefits of the workplace including a theory of knowledge management developed in organisations.

This is not a comprehensive literature survey by any means and it remains perhaps the domain of a translational developer who might aspire to the top level of the EDAC accreditation stages to carry out such a study as part of a doctoral project. It has to be noted, however, that there are a myriad of publicly available papers that are not rigorously methodologically based or peer reviewed available.

They illustrate little evidence which can be used to inform the translational design of knowledge environments covering workplaces. Note that Duffy (1997) has been excluded as I don't see any evidence for his assertions and theories, although they are still extensively used today more than 25 years after their development. This testifies to the lack of any translational development in this field.

However, if we do take the research/practice dialogue as illustrated earlier, then maybe we should be looking more closely at the assertions made by practitioners as to the efficacy of their proposals and consider whether these actually do provide a form of evidence, despite the apparent lack of rigour. The idea of translational design as noted above is reciprocal, so if practitioners are seeking some deeper evidence to test concepts, then researchers should respond.

Practitioners like to use case studies to illustrate their practice and sometimes methodology so I will use a recently awarded project, the Shelley St office fitout for Macquarie Bank.

Organisational change within Macquarie 'drove' this design and it has to be said that many 'innovative' workplace designs are often driven by an organisation's wish to transform work practices in their workforce.

Macquarie sought a more team-based approach to its operations for a variety of reasons. So individuals had to come out of their silos (see Figure 9) and collaborate more.
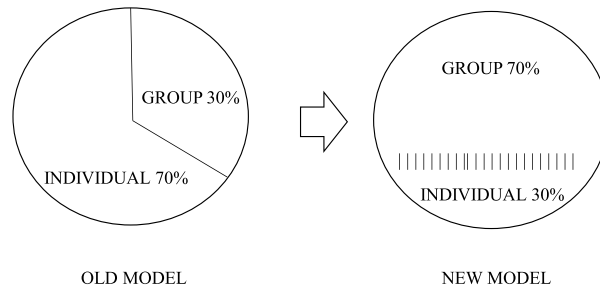
Figure 9. Group vs individual spaces
Source: Wilkinson (n.d.)

This meant a shift from 70% individual offices and workstations down to 30% and vice versa for collaborative or meeting spaces. The traditional single floor of meeting rooms- which I have seen in many merchant banks – had to become distributed for teams to access (Figure 10).
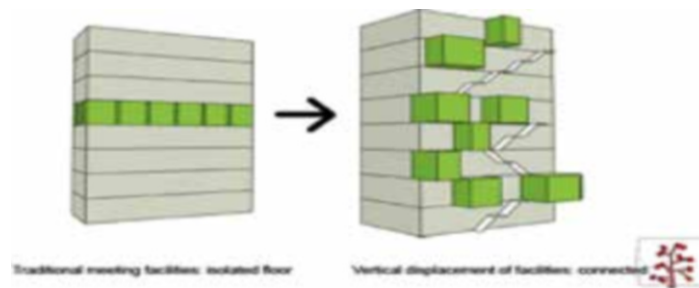
Figure 10. Distributed meeting rooms
Source: Wilkinson (n.d.)

Changing leadership aspirations included the impact of information technology, increasing competition for staff, downward pressure on costs, the realisation that office space is often highly under-utilised and the consequent development of new ways of working (Baldwin, n.d.).

Macquarie suggest the workplace is measured in three key ways – *efficiency* i.e., making economic use of real estate and driving down occupancy costs; *effectiveness* i.e., using space to support the way that people work, improving output and quality and; finally, *expression* i.e., communicating messages both to the inhabitants of the building and to those who visit it, to influence the way they think about the organisation – getting the most from the brand (ibid).

In supporting the negative views of open plan office space design, Macquarie felt that the concept doesn't encourage communication and collaboration (people

14

still work in silos), that people need places to concentrate, that interruptions were costly (in that staff still needed at least 15 minutes of 'immersion time' before returning to optimal levels of concentration following an interruption) and that people typically spend less than 50% of their time at their desk in their business of merchant banking.

Macquarie states that the lessons learnt from research into activity based working 'is that a variety of work settings should be available based on the activity undertaken by each individual and team, balancing the need for concentration and communication' (CABE, 2005). It also suggests that a definition of activity based working (ABW) includes no allocated desks (people choose a working setting appropriate to their task); wireless network coverage – everybody has a laptop computer and a mobile telephone; teams have a home base (anchor point) for team storage and personal storage in a locker; follow-me printing allows people to access print/copy facilities anywhere in the building, and finally projection screens in all meeting spaces to discourage paper usage.

Critical to the process was a change management programme made up of the following elements (Baldwin, n.d.): communication, communication, communication, communication (sic), project structure, business engagement and consultation, change champions, intranet site, regular emails, pilot floor, blogs, e-learning, face to face change program for leaders and people, follow-up one-day workshops, technology training, signage, communications – reinforcement of behaviour change, leader workshop and induction.

The concept also provided some challenges for client visits and confidentiality, so these meeting rooms were located in the public zone of the public-invited-private areas of the operational floors, as can be seen in Figure 11, which is largely identified by the publicly accessible 'tree' otherwise known as the atrium.

Activity based workplaces for individual and group work are satisfied by a range of 'affordances' comprising a number of settings (Figure 12). These are arrayed over the floorplate in a variety of combinations depending on the type of work activities that a particular team is carrying out, whether it be auditing, pitching for a project developing a prospectus or other (Figure 13). The dilemma begins to appear when we examine the 'evidence' of how successful the design concept has been. Some of the measures included:

- Engagement was up 35%
- 50% less energy used
- 60% of occupants believe they are more effective
- 70% less use of paper
- Long term business benefits
- 93% would not go back to desk ownership.

There some 'wins' but, in other projects – especially in universities, for example – additional individual personal and confidential interviews have elicited very unhappy office workers, with many wearing headphones to develop a sense of privacy for

Figure 11. The tree of meeting and social spaces
Source: Wilkinson (n.d.)

Figure 12. The activity settings matching work practices
Source: Wilkinson (n.d.)

some of their work. Organisations are not keen to share their research methodologies and so it is difficult to critique this case study.

Nevertheless, using the performance measures noted above – and it is excellent to see these established before the project was designed, not after – the published

Figure 13. Team space
Source: Wilkinson (n.d.)

evaluation (Baldwin, n.d.) found that in terms of *efficiency* the AWB approach increased the capacity of the building from 2,850 people to 3,500 people.

Savings due to lack of churn were estimated as $3.1 million, savings due to environmental design initiatives – $870,000. With regard to *effectiveness* over 90% of staff surveyed post move said they wouldn't go back to the old way of working, 59% said they were 'more effective' at work because of the new way of working, 98% supported the cultural change embodied in the new workplace. Furthermore, service level performance metrics of the staff in the client contact centre have improved on previous productivity benchmarks. The evaluation also notes that 'research shows that the workplace is responsible for 24% of job satisfaction which affects staff performance by 5% for individuals and – because of the benefits of improved interaction – by 11% for teams'.

Concerning *expression*, there were 37,286 visitors to the building in the 1st year, over 40 articles published in popular, industry and the design press globally, there were over 20 industry awards for the building, the workplace and the sustainability initiatives, tours requested for CEO's from Qantas, Credit Suisse, CBA, Lend Lease, Suncorp, Westpac, Westfield and Telstra, 60% of the building occupants invited family or friends to see the new workplace in the 1st 3 months and the Group Head for Business Financial Services talks about brand cohesion – the building enables BFS to 'walk the talk'.

The workplace area of knowledge environment design is ripe for a translational developer to dig deeply into a methodologically robust research project in partnership with a practitioner and willing client to develop some true evidence on the effectiveness of activity based work-settings. But for such a solution to be truly evidence-based, the research project would have to be trialled many times and arguably in a double-blinded manner before it could be truly cited as a principal source on which to design such settings. Such projects are difficult to find funding for, and so the domain remains a little bereft of sufficient evidence to support such initiatives, other than in innovations.

Another knowledge environment domain that is beginning to replicate research projects is that of learning environments, to which I now turn. Indeed both the health and AWB office examples illustrated above form a strong basis for understanding how EBD might be applied in learning environments.

THE LEARNING ENVIRONMENT

Many of innovative spatial developments in formal and informal learning environments are being instigated primarily through initiatives led by information communication and technologies (ICT) departments, particularly in universities (Marmot & haa Design, 2004). In parallel with the reengineering of these formal spaces is a profusion of informal learning commons, learning hubs and learning centres to encourage students to spend longer hours on campus with their peers.

Educause (2014), a non-profit association whose mission is to advance higher education by promoting the intelligent use of information technology, notes that we also need to incorporate the extraordinarily rapid advances in social networking, such as Twitter, Facebook and so on, which can all be used in learning frameworks. Relatively rigid physical learning spaces must adapt to meet the emerging needs of a wide range of workplace pedagogies for a variety of professional disciplines.

But 'good teaching' must still have a role to play; the role of the mentor will remain critical, whether the mentor be virtual or physical. Whilst there is still a resistance to the use of the virtual, for example in trade training, it is without doubt that the use of simulation will become the norm as the Australian National Broadband Network unfolds over coming years. Good teaching understands how learners learn, and that learners are multi-modal, multi-skilled and multi-tasking in the way that they learn. There are myriad learning styles as illustrated in Figure 14 and it is difficult to see how all of those learning style options can be utilised in the standard classroom.

Putting 25–30 students in one classroom – whether it is 7 year olds or 17 year olds or older students in post secondary environments – limits the opportunity to differentiate teaching and support a range of learning styles. Classroom dimensions are of the order of 60 square metres for approximately 30 students, or variations of 2 m^2 per student. The alternative layouts for students with this area rating only allows for students facing the front, and groups cannot be formed. Studies by this writer have determined that a minimum of 2.7 m^2 per student is needed to allow for collaborative configurations, and preferably 3 m^2 per student. If wheelchair access is required more area is needed

There are a wide range of cognitive and neuroscience-based styles of learning for which social construction of learning must be accommodated. Clearly such an approach requires a wide range of learning spaces other than the 19thC outdated classroom. Although pedagogy is still critical in the early years of learning, some of the concepts in Figure 14 are increasingly being taught to students at young ages (Hase & Kenyon, 2010).

Generic and other constitutionally based factors
- Gregorc's Mind Styles Model and Style Delineator
- The Dunn and Dunn model and instruments of learning styles

The cognitive structure family
- Riding's model of cognitive style and his Cognitive Styles Analysis (CSA) stable personality type
- The Myers-Briggs Type Indicator (MBTI)
- Apter's reversal theory of motivational styles, the Motivational Style Profile (MSP) and related assessment tools
- Jackson's Learning Styles Profiler (LSP)

Flexibly stable learning preferences
- Kolb's Learning Style Inventory (LSI)
- Honey and Mumford's Learning Styles Questionnaire (LSQ)
- The Herrmann 'whole brain' model and the Herrmann Brain Dominance Instrument (HBDI)
- Allinson and Hayes' Cognitive Style Index (CSI)

Learning approaches and strategies
- Entwistle's Approaches and Study Skills Inventory for Students (ASSIST)
- Vermunt's framework for classifying learning styles and his Inventory of Learning Styles (ILS)
- Sternberg's theory of thinking styles and his Thinking Styles Inventory (TSI)

Figure 14. Post secondary learning styles
Source: Adapted from Coffield et al. (2004)

When these students become secondary school learners they are expected to have some attributes of adult learning, although it is noted that skills development is critical and that in many instances training or explicit instruction is still needed for some students at some stages (Figure 15).

Ultimately, though, as we move through life changing jobs – it has been argued, eight times in our working lives – we need to be autonomous learners able to re-skill into our new working domains. The rapidly emerging models of technologically-enhanced learning and learning environments or TEAL – first introduced under that term at the Massachusetts Institute of Technology (MIT) in 2000 – emphasise the role that acoustics, furniture, lighting (both natural and artificial), mobility, flexibility, air temperature and security play in supporting the new and emerging learning technologies designed for those spaces. But this is insufficient evidence to suggest we proliferate these designs.

Now there are a number of TEAL evaluations (Fisher, 2010) emerging that can support the further development of this model of learning and learning environment. For example the Experience 1 Future Learning Space was introduced to meet the pedagogical and student engagement needs, outlined above, around the teaching of engineering at UniSA (University of South Australia). There has been an evaluation covering a range of key areas (Smith et al., 2011) examining issues such as the
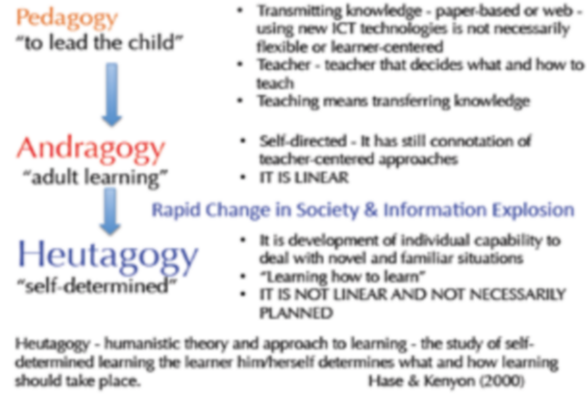
Figure 15. Transitions in teaching and learning practice
Source: Adapted from Arbab (2012)

aesthetics of the space and what messages students were receiving, (e.g., did they feel safe, positive, student satisfaction); the *function* of the space to determine how the students were using the environment and if the infrastructure (e.g., computers, appliances) was supporting them in their learning and socialising; measuring the *flexibility* of the space; and, indirectly, the *impact* on the student experience and learning outcomes.

A range of research tools was used for the evaluation. A survey of all first-year engineering students was conducted two months after students were first allowed access to the space. This survey reviewed many aspects of first-year experience and had several items that specifically drew information about the Experience 1 Studio.
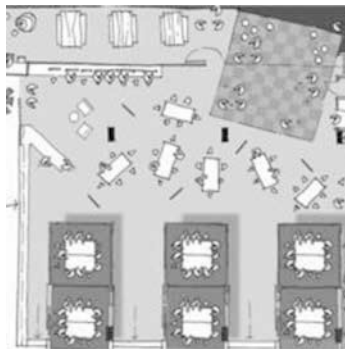
Figure 16. Experience 1 studio floor plan
Source: Woods Bagot

Figure 17. Experience 1 studio agile seminar room
Source: Woods Bagot

A similar anonymous survey was repeated towards the end of the year of occupation. Student focus groups were also organised to more deeply explore the issues raised in the surveys and to allow investigation into other issues. Students were asked to map their typical travels within the first year experience of the space (Figure 16).

A study on how the walls within the Experience 1 Studio were adjusted to create different spaces was conducted over one week (Figure 17).

To facilitate meta-cognitive talk (discussion of thoughts and thinking) a selection of visual methods were used in a photo-elucidation activity. Random focus group participants were provided with disposable cameras and asked to capture what the first year engineering space meant to them. These images were used to facilitate discussions about meaning in subsequent focus groups.

A comparison of grade outcomes was made for the four first semester courses before and after student access to the Experience 1 Studio. In summary the key outcomes were: a positive influence on student learning that in some cases has translated to better learning and social outcomes; student retention has also improved – although it is considered that this is hard to measure accurately as there are many other factors that impact upon retention; the student creation of a new club (the Amalgamated Engineering Recreational Organization – AERO), that spans the civil, mechanical and electrical engineering students (previously each program had their own club); students enjoyed interacting with their peers in other engineering programs as significant improvements to learning outcomes emerge in adopting this approach.

A crucial outcome included a much clearer understanding of the complex elements which impact on the design of a learning environment, as illustrated in Figure 18. Additional findings are reinforcing the need for teachers and lecturers to be supported as they move into new learning spaces (OLT, 2012). It is not enough to provide new, technologically connected learning spaces without giving teachers and lecturers the time, space and guidance to build collaborative teams of students, teachers and tutors.
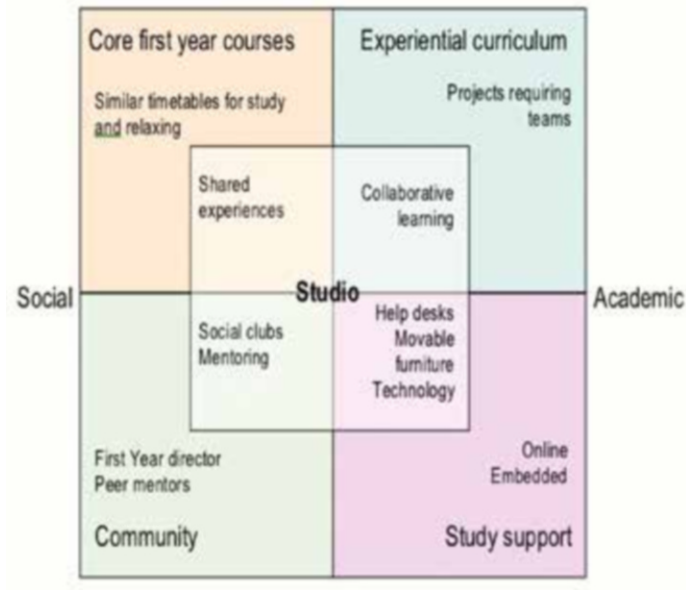
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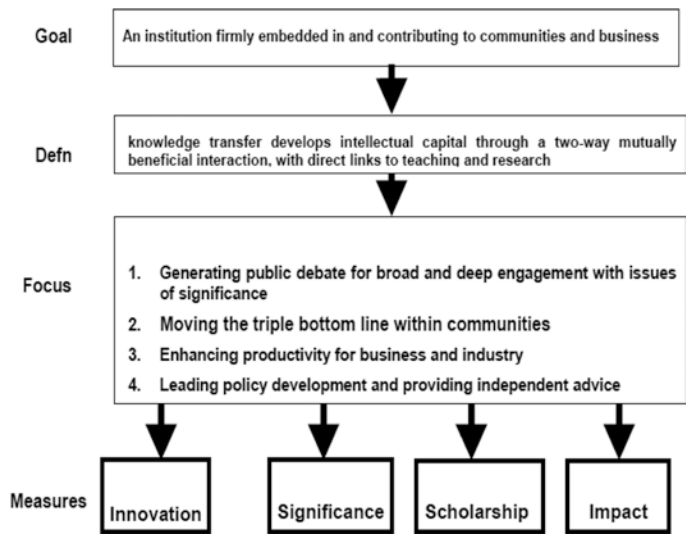*Figure 18. The experience 1 pedagogical framework*
Source: UNISA

Figure 19. Knowledge partnerships model
Source: University of Melbourne

CONCLUSIONS

What will the future hold for the evidence-based design of learning environments? We are told that the university might well take a completely different form (Ernst & Young, 2012) in a decade or two and that heutagogy may well be the dominant mode of post-secondary learning and knowledge construction (Hase & Kenyon, 2000).

It may be that universities will move 'forward to the past' and emulate where the university and the community become almost indistinguishable such as was (and still is) the case at Oxford and Cambridge centuries ago. Increasingly as educational institutions evolve they are likely to be more engaged with the community so that transformative development will become more common (Figure 19). We will all need and prefer to construct knowledge collaboratively (Gibbons et al., 1994) both face-to-face and virtually.

As noted at the beginning of this chapter, the transformation of design thinking is being heralded through the evidence-based design approach in health facilities planning which itself is based on the medical model of clinical translational research trials.

We now need to look at *transforming design thinking* to support a rapidly changing psycho-socio cultural environment through the idea of *translational developers* where educational planners apply the practice of *translational design* using evidence to shape our future learning environments.

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2. ADDRESSING THE SPATIAL TO CATALYSE SOCIO-PEDAGOGICAL REFORM IN MIDDLE YEARS EDUCATION

INTRODUCTION

For many years in Australia, academics and state government departments have promoted learner-centred and constructivist pedagogies in the middle years of schooling (Years 5–9) (Barratt, 1998; Beare, 2000; Carrington, 2006; DEECD, 2010; DEET, 2002; Hill & Russell, 1999). However, such approaches have still not been widely adopted (Black, 2009; Cartmel, 2013; Pendergast, 2006; Pendergast & Bahr, 2005).

A number of factors have hampered pedagogical reform. These have included: staff being unable or unwilling to participate in ongoing professional development; changes in leadership resulting in loss of a vision and/or financial commitment; lack of continuity in teacher cohorts; and failure to establish protocols to determine the efficacy of the reform process (Pendergast, 2006). Additionally, a 'deep spatial silence' – i.e., limited recognition about the power of space and the influence that it has over school organizational structures and learning – may have restricted the reform agenda (Fisher, 2002).

McGregor (2004b) concluded that the traditional classrooms, conceived during the Industrial Revolution and designed for students to passively receive information, have restricted school-based education to a narrow range of learning modalities and experiences. She and other academics have expressed concern about the limitations of educating today's students in such environments (e.g., Fisher, 2002; McGregor, 2004a, 2004b, 2004c; Upitis, 2004).

This concern appears to be warranted when the pedagogical intention of middle years education is to involve students in activities that involve higher order thinking (Bloom et al., 1956), experiential learning (Dewey, 1966), critical pedagogy (Friere, 1970), communication and collaboration (Vygotsky, 1996) and learning across Multiple Intelligences (Gardner, 1993, 1999).

A PhD project undertaken as part of an Australian Research Council Linkage project entitled *Smart Green Schools* and conducted in Melbourne, Australia investigated how changes to the physical environment might influence a) the fundamental conditions of teaching and learning for students and teachers (Elmore,

1996), and b) the ability of school communities to engage in holistic educational reform.

As depicted in Figure 1 (below), the findings concentrated on the relationships between innovative middle years' learning environments, constructivist pedagogies and student engagement. For the purposes of the study, learning environments were defined as built environments designed as places for learning, inclusive of building structures, furniture, fixtures, technologies and resource objects.
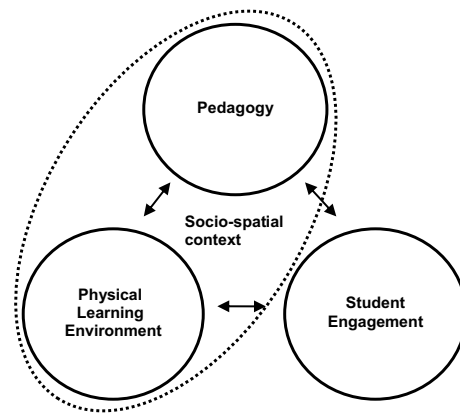
Figure 1. The study's field of inquiry: The relationships between physical learning environments, pedagogies and student engagement

BACKGROUND

In keeping with the focus of the study, the review of selected background literature that follows explores; calls for education reform; the construct of student engagement and its importance in middle years' education; recent changes to the physical learning environments in Australian schools; and the influence of the physical environment on students' educational experiences. At the intersections of these bodies of literature, gaps in the literature are identified.

Calls for Pedagogical Reform vs. The Inertia of Resident School Cultures

A new backdrop for middle years educational reform came into existence during the early 2000s – characterised by social, economic, political and cultural shifts and, perhaps most importantly, the development of new forms of information access and methods of communication enabled by digital technologies (Carrington, 2006). The types of reforms proposed at this time included those outlined by the *Middle Years Research and Development (MYRAD) Project* (DEET, 2002, p. web).

This report recommended:

- Strengthening teacher-student relationships
- Involving students in decision-making about content, process and assessment
- Presenting authentic tasks that require complex thought and allowing time for exploration
- Inclusion of processes involving co-operation, communication, negotiation and social competencies generally
- Providing for individual differences in interest, achievement and learning styles.

However, it is generally agreed that reform initiatives in the middle years' have not been widely adopted (Black, 2009; Cartmel, 2013; Pendergast, 2006; Pendergast & Bahr, 2005). Indeed, the reform agenda appears to have suffered from what Elmore described as the inertia of resident school cultures that lead school communities to powerfully resist change (Fullan, Hill & Crevola, 2007).

Student Engagement: Sub-Types and Influence

The importance of engaging middle years' students in learning and with school has been well documented. Researchers have identified that students in the middle years' have become increasingly alienated and disengaged from school (DEET, 1999) and have identified academic stagnation as detrimental (Carrington, 2006; Hill & Russell, 1999). Notably, the *Melbourne Declaration on Educational Goals for Young Australians* (MCEETYA, 2008, p. 12) concluded that, "focusing on student engagement and converting this into learning can have a significant impact on student outcomes".

Following a review of 160 studies on student engagement, Fredricks, Blumenfeld, and Paris (2004) identified three engagement subtypes. These are paraphrased below:

a. *Behavioural engagement,* which draws on the idea of participation and includes involvement in academic and social or extracurricular activities.
b. *Emotional (or affective) engagement*, which encompasses positive and negative reactions to teachers, classmates, academics, and school and is presumed to create ties to an institution and influence willingness to do the work.
c. *Cognitive engagement,* draws on the idea of investment (in learning) and incorporates willingness to exert the effort necessary to comprehend complex ideas and master skills.

Disengagement is believed to lead to detrimental outcomes for individuals and associated problems for the wider community. For individuals, the consequences of disengagement included a greater likelihood of leaving school early with inadequate qualifications (Kortering & Braziel, 2008; OECD, 2000), fewer opportunities to participate in further education (OECD, 2000), and difficulties finding stable employment (Kortering & Braziel, 2008).

Physical Learning Environments in Australian Schools

In 2002, Fisher suggested that education reform agendas have been restricted by limited recognition of the influence that space has over school organizational structures and learning. However, in recent years learning environments in schools in Australia and across much of the western world have been undergoing a process of transformation (OECD, 2009). Through this process the spaces in which students attend school are being rethought and redesigned.

In Australia, the transformation of school infrastructure was aided by a flurry of government funding schemes, the most prominent being the Federal Government's Building the Education Revolution (BER). From early 2009, the BER program distributed $16.2 billion to fund 24,382 building and infrastructure projects in 9,526 schools nationwide (DEEWR, 2010).

This nation building economic stimulus package was initiated in the wake of the 2008 global financial crisis. With investment on this scale, and a loosening of the school infrastructure design guidelines in some Australian states, most notably in Victoria and Western Australia, innovatively designed new school buildings literally 'popped up' across the nation between 2009 and 2011.

The Influence of the Physical Environment on Students' Educational Experience

Some highlights of the limited body of research into the relationships between learning and space are outlined below.

Based on studies of human-environment interaction in schools, Weinstein (1981) recommended that the physical environments in schools should be considered to be as important as the curriculum. She proposed that physical environments could have an impact on learning through the moderation of social, psychological and instructional variables.

She suggested that the physical spaces in schools could 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. Weinstein concluded that the physical aspects of learning should be carefully planned to match teaching objectives and the learning needs of students.

As a human geographer, Fielding (2000) described unequal institutional power relations as having moulded the behaviour of students for many years. He described the degree to which students were active participants in the use of space as being largely dependent upon the structuring of the teaching, learning and management within a school.

He identified school settings in which the 'geographic moral code' was negotiated by students and teachers as positively fostering collaborative learning practices, greater fluidity of movement around the classroom, a greater amount of on-task talk within groups and little pointing, leaning over or shouting. On the other hand,

he equated authoritarian derived pedagogy with a 'much smaller classroom', even though the physical space remained the same. With this reduction in classroom 'space', he suggested that students' geographic experiences were restricted.

Through an ethnographic study of schools in the Los Angeles area, Monahan (2002, 2005) developed the concept of 'built pedagogy': a valuable theoretical lens through which to interrogate the influence of space on educational practice. He defined built pedagogy as "the architectural embodiments of educational philosophies" (Monahan, 2002, p. web) and suggested that school spaces informed students and teachers about how they should behave by providing them with a 'script' to follow.

Furthermore, Monahan (2005) contended that built pedagogies operated along a continuum between discipline and autonomy. At one end, he suggested that space may restrict learning opportunities by not allowing for certain movements, flows or activities (discipline), while at the other end, learning environments may enable individuals to interpret space and use it as they see fit to meet their particular needs (autonomy).

Gaps in the Literature at the Intersection of Space, Pedagogy and Student Engagement

A broad review of the literature indicates that research into the influence of the physical environment on both pedagogic practice and student engagement is limited. In 2004, McGregor (2004c) suggested that the significance of space had only recently become acknowledged in education and claimed that only a few people within the education community were engaged in discourse about the impact of physical space on learning. Within the context of middle years' reform, the literature revealed only fleeting mentions of school building design or physical learning environments (e.g., Beare, 2000; Smyth, McInerney, & Hattam, 2003; Janowska & Atlay, 2008).

What influence innovatively designed learning environments, characterised by their interconnected spaces and high levels of resourcing, may have had on teaching and learning and the ability of school communities to engage in holistic educational reform has become a major issue in Australia. Although there was a global movement towards creating resource-rich buildings that are intended to support contemporary approaches to teaching and learning (Burke & Grosvenor, 2008; Dudek, 2008), little research at the time of the study had focussed on the effectiveness of these facilities in supporting constructivist pedagogies and student engagement – especially in the middle years.

Informed by research into middle years' education and student engagement that emerged from the late 1980s, the study described here sought to investigate the triadic relationships between innovatively designed learning environments, pedagogies and student engagement in the pursuit of new knowledge about how physical learning environments might be better designed and used to support the constructivist pedagogies professed by middle years' researchers to improve student engagement (Barratt, 1998; Carrington, 2006; DEET, 2002; Hill & Russell, 1999; Pendergast, 2006). By examining middle years' education through a spatial/geographical lens, it was hoped that new dimensions could be added to the discourse surrounding middle

31

years' education and that the study's findings could aid the ongoing nationwide project of middle years' reform.

RESEARCH DESIGN

The key research question asked in the study was:

How can middle years' learning environments be designed and used to support contemporary constructivist pedagogies and improve student engagement?

To address this question, theoretical perspectives from the disciplines of education, architecture and human geography were married to investigate how spatial design might influence pedagogies and student engagement. Due to the breadth of the subject matter under investigation, an interdisciplinary perspective was considered essential. As different epistemologies tend to be favoured by different disciplines, an interdisciplinary approach was chosen to facilitate the creation of new knowledge regarding the socio-spatial and geo-pedagogical relationships that were central to the research question. Figure 2 (below) summarises the research foci of the study.
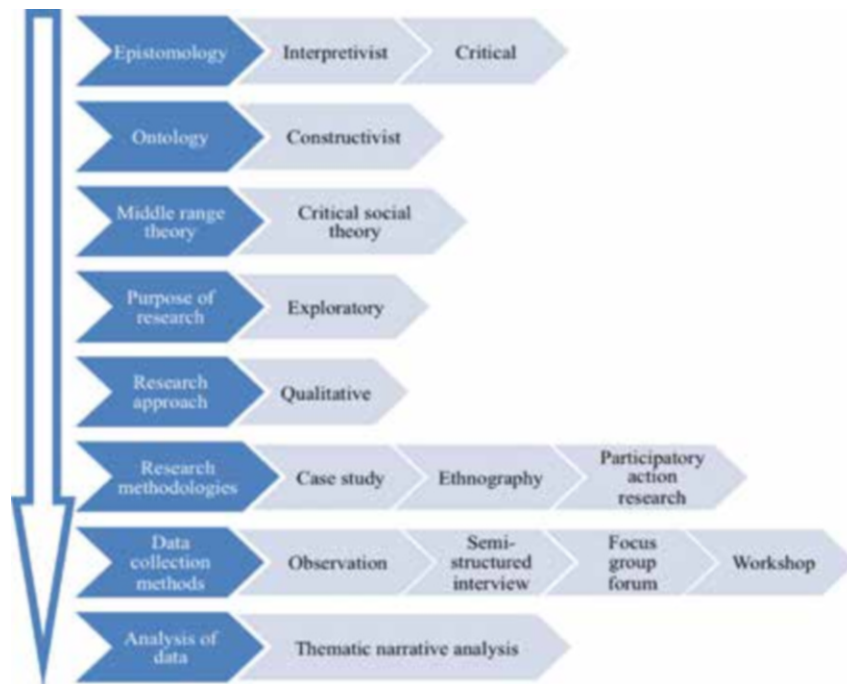

Figure 2. Design of the study

In keeping with this framework, the study investigated the architectural response to a shift in educational practice that embraced learner-centered education models in three Melbourne-based schools. A critical analysis of middle years' learning environments was developed using multiple case study (Bryman, 2004), ethnographic (Bryman, 2004; Hammersley, 1999) and participatory action research methodologies (Cohen, Manion, & Morrison, 2007; Mattsson & Kemmis, 2007). The multiple case study approach enabled the research question to be investigated though the perspectives of the people directly involved in creating and using new learning environments. The field based research was conducted in schools where middle years' learning environments had been purpose built to support constructivist pedagogies.

Data were collected between September 2008 and September 2010 using a variety of qualitative methods including observation of teaching and learning – in some instances before and after the provision of the new spaces; semi-structured interviews with school leaders, teachers and students; focus groups with teachers; and workshops with school leaders, teachers and architects. Table 1 (below) outlines the dates of the significant data collection events that occurred throughout the course of the study. The principal reason(s) for each site/school visit are indicated.

The data collected were analysed using a process of thematic narrative analysis adapted from Riessman (2008). Using this technique, the data from individual cases (observational notes, interview transcripts, and summary notes from focus groups and workshops) was not fractured or segmented into thematic categories for cross analysis; instead, individual cases were maintained intact for coding. By preserving the data within each case in long chronological sequences, the finer details of the stories embedded in the data were able to be interpreted within historical contexts, with attention paid to both micro and macro contexts.

The identification of micro contexts revealed isolated issues and events that shaped the social settings in the case study schools, while an exploration of macro contexts revealed some of the forces acting on the settings' social structures—such as power relations, hidden inequalities, hidden dependencies and historical contingencies. Through the interpretation of individual cases, understandings of the socio-spatial settings and socio-pedagogical cultures of practice within the case study schools were formed.

Theoretical Frameworks for Analysis and Discussion

A number of analytical frameworks were used to explore the learning/space nexus. In keeping with the critical epistemological position that informed the study, the following domains/disciplines provided lenses through which to analyse and interpret the field data: critical pedagogy; critical theory of space; critical human geography: behaviour settings theory; complexity theory, and complex adaptive systems theory.

Table 1. Snapshot of fieldwork/data collection activity at the three sites (schools)

School A	School B	School C
2008	**2008**	**2008**
Sept 2 – Observation	Sept 8 – Parent information session	Oct 29 – Meeting with school leaders
Sept 10 – Meeting with school leaders	Nov 11 – Meeting with school leaders	Dec 1 – Forum/workshop to review
Nov 7 – Interviews with school leaders	Nov 26 – Staff professional development	current setting in the Hub
and teachers	day	
Dec 5 – Interviews with school leaders		**2009**
and teachers	**2009**	Feb 11 – Meeting with school leaders
Dec 11 – Observation	27 Jan – Meeting with school leaders and	Feb 26 – Interviews with school leaders
2009	observation	and observation
Jan 29 – Meeting with school leaders	Feb 11 – Design session with students and	Mar 12 – Observation
Feb 10 – Meeting with all Year 7 and 8	observation	April 30 – Observation
teachers and planning session with select	Feb 20 – Interview with Principal	May 14 – Review forum with teachers
Year 7 and 8 teachers	May 11 – Meeting to discuss furniture	May 28 – Observation and review forum
Feb 24 – Planning session with select Year	selection and observation	with teachers
7 and 8 teachers	May 15 – Meeting to discuss furniture	July 30 – Meeting with school leaders
May 8 – Observation	selection	July 31 – Meeting with students
May 21 – Observation	May 26 – Observation and meeting to	Aug 10 – Observation
June 4 – Observation	discuss furniture selection	Aug 20 – Visioning and design workshop
June 18 – Observation	June 9 – Observation and informal	Nov 6 – Interviews with students
July 21-22 – Curriculum review and	discussion with teachers	
development team meeting	July 6 – Informal discussion with teachers	**2010**
Aug 7 – Forum with teachers and	Aug 12 – Observation and informal	May 2 – Inspection of Hub refurbishment
observation	discussion with teachers	Sept 15 – Review forum with teachers
Aug 13 – Forum with teachers and	Aug 27 – Interviews with teachers	
meeting with school leaders	Oct 16 – Observation and informal	
Sept 16 – Interviews with school leaders	discussion with teachers	
and teachers	Nov 10 – Learning spaces multimedia	
Oct 29 – Interviews with teachers and	activity with students	
students	Nov 17 – Review forum with teachers and	
Nov 12 – Interviews with students	interviews with students	
2010	Dec 17 – Interviews with students	
Jan 28 – Review forum with school		
leader, teachers etc.		
Feb 11 – Review forum school leaders		
and teachers		

The lens of critical pedagogy (Freire, 1973; Friere, 1970; Giroux, 1985) was used to examine the motivations, objectives and intentions of those who directed the spatial and pedagogical projects in the case study schools – namely the school leaders. This lens was used to examine their educational rationales for change, their educational visions for the future, and the expectations they held about the influences that innovative learning environments may have on middle years' socio-spatial contexts and socio-pedagogical cultures.

Perspectives derived from the literature on critical theory of space (Soja, 1989) and critical human geography (Fisher, 2002; Foucault, 1972; Hirst, 2005; Lees, 2001; Lefebvre, 1991) were used as an overarching perspective from which to discuss how teachers and students used and experienced space. In particular, Soja's (1989) theories about how critical spatialization may open up avenues for the (re) interpretation of social histories were used to examine the events that occurred as teachers and students made the transition into new learning environments.

Behaviour settings theory (Barker, 1968) was used to discuss the influences that 'units of the environment' had on the behaviour of teachers and students. As behaviour settings theory recognises both physical and social components of the environment, this theoretical lens matched particularly well with the focus of the study on the relationships between the physical learning environment, pedagogy and student engagement.

In order to build on the discourse that was initiated by Upitis (2004) regarding the connections between complexity theory, educational practices and school architecture, complexity theory (Heylighten, Cilliers, & Gershenson, 2007) and complex adaptive systems theory (Law & Urry, 2004) were used to develop understandings of the emergent behaviours that occurred in the case study schools. These conceptual tools enabled discussion of the effectiveness of the new learning environments in the case study schools and the development of ideas regarding what role architecture could play within a complex adaptive system of education.

CASE STUDY SITES

The selection of case study sites was made using a process of convenience sampling (Bryman, 2004). The three schools (given pseudonyms) were state funded public schools located in metropolitan Melbourne however they differed in a number of ways: one was a primary school, the other two were secondary schools; the schools catered for significantly different numbers of students; the communities served by the schools were stratified by socioeconomic status; the schools were geographically distributed across the metropolitan area (each was situated within a different Department of Education and Early Childhood Development regional office zone); and the designs of the new 'innovative' learning environments varied between schools.

The sites are introduced below. The information provided includes: an overview of each school; details of recent infrastructure changes; a brief description of the learning environments/settings that were studied; and a brief outline of the research process conducted.

School A – Suburban HS

Suburban HS was a large co-educational school located in outer metropolitan Melbourne. It was attended by more than 2000 students in Years 7 to 12

(in 2009–2010) and employed 250 teachers and auxiliary staff. Many of the students were from disadvantaged socio-economic backgrounds, with a high proportion of the school's families being recent immigrants to Australia. The school was formed in 2009 following the merger of three existing schools. It was hoped this amalgamation would improve the educational outcomes for students in the area.

Fieldwork at Suburban HS was conducted mainly within one of the school's new 'school within school' buildings – facilities designed to house 300 students from Years 7–12. The focus was on the educational settings on the first floor, where three teachers, and cohorts of 50 Year 7, 50 Year 8, and 50 Year 9 students (not included in the study) were accommodated (see floor plan in Figure 3 below).
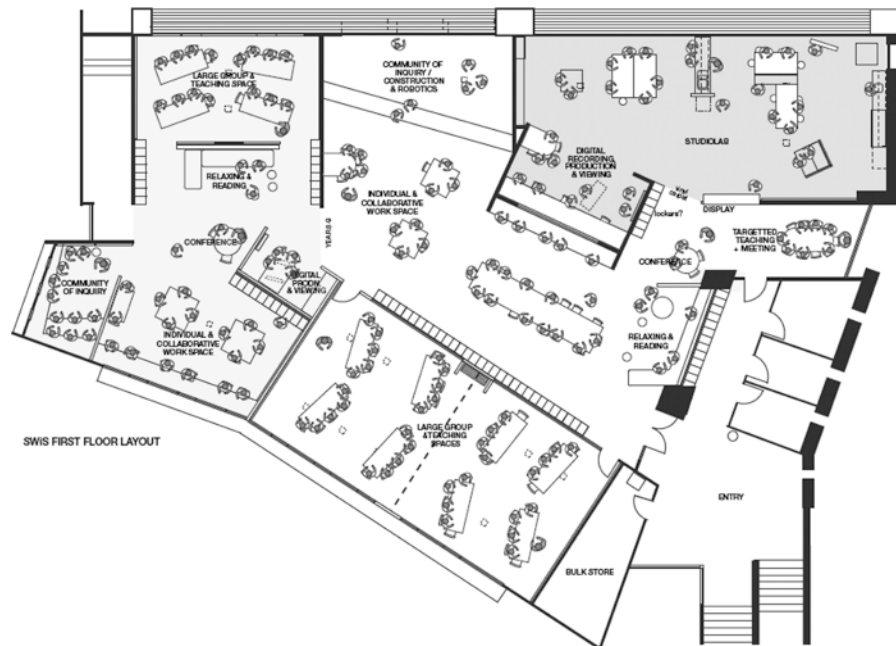
Figure 3. Suburban HS: SWiS building first floor
(Image: Hayball and Mary Featherston Design)

School B – Inner City PS

Inner City PS was a small co-educational school that catered for 275 students in Prep to Year 6 (2008–2010). The school campus, located on a compact site in a privileged socio-economic area in an inner suburb of Melbourne, was first established in 1873 (now heritage listed buildings). Less than 10% of students were from homes where a language other than English was spoken (citation withheld).

In 2008 a new Principal and Assistant Principal had inherited a building refurbishment project in its early stages. The focus of this project was on updating the Year 5/6 learning area. The incoming Principal wished to create a more engaging educational experience for the Year 5/6 students, who he viewed as highly able but insufficiently challenged. He wished to shift from an educational model that was defined by a social organisational structure of 25 students working with a single teacher, to a new model based on three teachers working collaboratively with 75 students. He viewed the building project as a significant opportunity to realise this goal. The majority of fieldwork undertaken at this site was conducted within the Year 5/6 area, as depicted in Figure 4 (below).
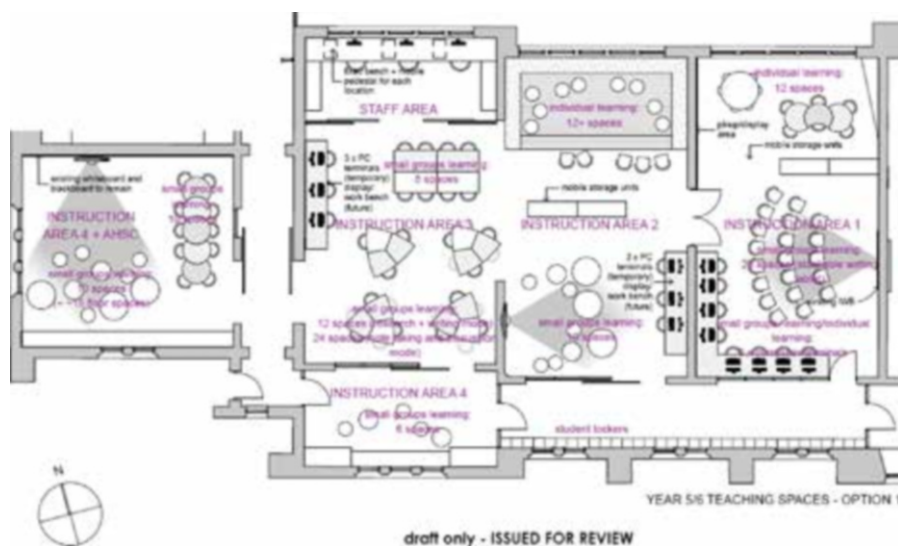
Figure 4. Inner city PS: Year 5/6 area following renovation/refurbishment in 2009
(Image: Cathi Cola architects)

School C – Seaside SC

Seaside SC was a co-educational school with a student population of more than 1400 in Years 7–12 (2008–2010). The school was located in a bayside suburb of Melbourne with a high socio-economic status. The middle years' campus (Years 7–9) was the focus of the research at this school. Significant changes were instigated at this campus in 2000, when Seaside SC merged with a school that had previously occupied the site. The merger of the two schools coincided with a $13 million building program that brought about the demolition of the campus' existing buildings and the construction of new buildings – first occupied in 2007.

The new buildings comprised traditional classrooms, with the exception of a large space known as the 'Hub'. This space was the focus for the fieldwork at this site. Located on the first floor of Building B (see Figures 5 and 6 below), the Hub was equivalent in size to four traditional classrooms; including what would be a central corridor. Figure 5 (below) shows the Hub in 2008 when fieldwork began. Figure 6 (also below) depicts the same space in 2010, post-refurbishment.
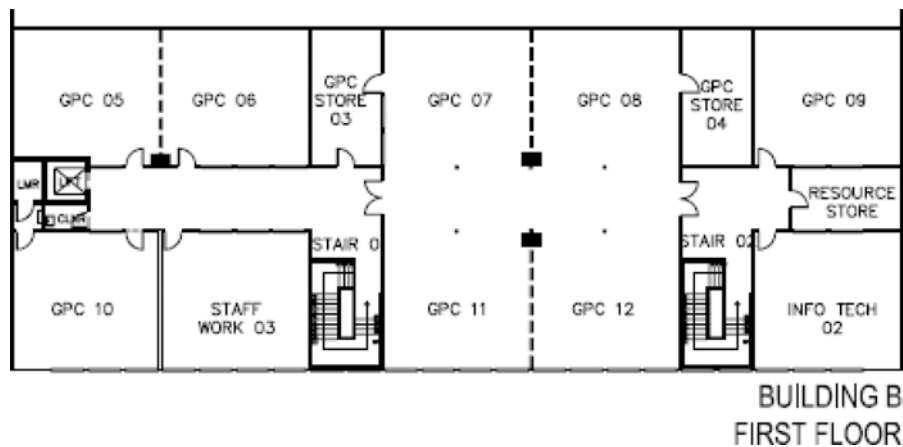
Figure 5. Seaside SC: The hub (GPC 7, 8, 11, 12) prior to refurbishment (Building B – First floor)

FINDINGS AND DISCUSSION

The findings that emerged from the data about students' and teachers' geo-pedagogical experiences in the case study schools – experiences associated with learning and teaching as seen through a human geographic lens – revealed that the innovatively designed spaces in the case study schools offered both opportunities and challenges to students and teachers.

The new spaces were found to catalyse pedagogical and cultural change by challenging the prior practices of inhabitants, but did not directly shape new practices or behaviours. Indeed, pedagogical and cultural change was only achieved after overcoming early tensions and resistance to change, particularly from teachers. While some responded positively to the educational and professional opportunities offered by the new spaces, others expressed unease, apprehension and apathy regarding new learning environments and associated changes to curriculum, pedagogy and assessment practices. Shifting teachers' pedagogical approaches required more than just the 'disturbance' that new spaces caused.

The majority of teachers required professional learning support in order to adopt constructivist pedagogies and further assistance from school leaders and others,

*Figure 6. Seaside SC: The hub refurbishment floor plan – Annotated
(Building B – First floor) (Image: Spowers architects)*

including educational consultants, before they took advantage of the pedagogical opportunities afforded by the innovative learning spaces.

The key findings arising from the study associated with students' and teachers' geo-pedagogical experiences within the new learning environments of the case study schools and the influence of this on student engagement are presented and discussed below, as emerged from the thematic narrative analysis of the data (Riessman, 2008).

*"Where is the Front"? Teachers' Early Experiences in Innovative
Learning Environments*

The geo-pedagogical experiences afforded by the new learning environments in the case study schools were vastly different from those afforded by traditional classrooms. For many teachers, the settings that confronted them were not familiar. The initial bewilderment that some teachers experienced when they first encountered the innovative spaces in their schools was highlighted in the following quote from a school leader at Suburban HS:

The kids were all standing around thinking what do we do now, and the teacher said to me, "Where is the front?", and I said, "What", and she said, "Where

is the front of the room, where do I stand?", and I said, "Well, wherever you want to stand", and she said, "No, no, no, to teach, where do you want me to stand?"

Confronted by interconnecting spaces, collaborative table settings, soft seating areas and ubiquitous computer access to students (via laptops and fixed computers), many teachers (and students) did not recognise the behaviour settings (Barker, 1968; Gump, 1980) in the new spaces. Not only were the physical components, or milieu, different from traditional classrooms, but the social components, including the human components and the program (standing patterns of behaviour) were foreign or had not yet been established. With two or three times the numbers of students in each cohort (50 or 75 depending on the school) and the expectation that three or four teachers would teach collaboratively, the social dynamics in these new environments were fundamentally different from those that teachers were accustomed to in traditional classrooms. As a result, teachers (and students) were initially uncertain about how to behave in these new settings.

Cultural Change, Collaboration and the Social Production of Innovative Learning Environments

Observations and interviews revealed that although innovative learning environments mediated new forms of social relations, many teachers were not initially empowered when it came to appropriating or manipulating unfamiliar settings to support their pedagogical objectives. In general, teachers lacked environmental competencies (Lackney, 2008). However, as their perspectives on how learning occurred changed, they developed new practices, began to embrace the educational opportunities afforded by innovative learning environments and developed new environmental competencies that allowed them to make better use of the innovative spaces. A teacher at Inner City PS commented:

Opening the student learning space has meant that we are interacting, planning, refining, philosophising, you know … It is constant. It is just this constant professional conversation that we are having and I think that part of the reason that we all get exhausted by the end of the week is because we are so stimulated by what we are doing. I've been teaching for over 20 years … but I'm finding it the best teaching that I have done.

The social production of space in the case study schools was driven by discourse and collaboration. Initially, teachers worked together in teams to develop and later refine new pedagogical frameworks in response to new physical settings and the expectations of school leaders – a process enhanced by the co-location of teachers in common study areas. Subsequently, ongoing discourse and collaboration with students supported the creation of shared understandings regarding the expected norms of behaviour. With this, new geo-pedagogical practices were developed.

Professional Learning and the Adoption of Constructivist Pedagogies

Shifting the value systems through which teachers framed their professional conduct was essential for bringing about pedagogical change. Engaging teachers in discourse about contemporary educational theory, as well as allowing time for reflection, were suitable techniques for developing their understanding of constructivist pedagogies and refocussing the lenses through which they interpreted what was going on in particular learning situations. In addition, the new environmental competencies that teachers (and students) developed enhanced their ability to employ constructivist pedagogies. With opportunities for spatial and pedagogical experimentation and reflection, ineffectual pedagogies and spatial usage schemas were cast aside, while those found to be more effective were continued and refined.

Thinking collaboratively and creatively about varied pedagogical approaches was integral to teachers adopting new roles as leaders of constructivist education. As they developed new environmental and pedagogical competencies, they became better equipped to take on the task of creating dynamic behaviour settings that could support socio-pedagogical cultures that were conducive to learning.

Towards Pedagogical Change

Poor design, characterised by limited spatial differentiation and poor acoustics, hindered the uptake of constructivist pedagogies. To accommodate the 'learning hum' associated with the verbal communication required of constructivist pedagogies, the inclusion of high quality acoustic materials was critical. Poor acoustic design was found to place pressure on teachers to revert to highly structured teacher-directed pedagogies. A teacher at Inner City PS commented:

> Sometimes it feels crazy, particularly in the larger space, and your teacher instincts go, "It's too loud, it's too loud. No one can work when it is like this". And sometimes that is the case, and you need to quieten them down. I'm not saying it's always great. Sometimes they are mucking around and you need to pull them back. But a lot of the time … they are really into what they are doing and they just want to share. And it comes out in our data—huge connectedness to other students here. They really help each other and they really support each other and they look after each other.

Traditional timetabling arrangements were also found to restrict the adoption of constructivist pedagogies. Lessons of a short duration (approximately 50 minutes) were found not to be supportive of constructivist learning, while lessons of a longer duration (up to 150 minutes) were identified to better support student participation in a variety of related constructivist learning activities.

The limited proficiency of teachers with technology also reduced opportunities for students to learn via virtual/digital learning experiences, such as inquiry-based, self-directed project work.

Students' Transition into Innovative Learning Environments

The majority of students across the three case study sites made the transition into the innovative learning environments at their respective schools with relative ease. They enjoyed their new geographic freedom and the variety of pedagogical encounters that their new spaces enabled.

An exception to this ease of student transition was witnessed at Seaside SC before the Hub was refurbished. In its original state, this large homogeneous environment left students unsure about how they should behave or participate in learning activities. Such uncertainty placed significant pressure on teachers to try to socially produce appropriate behaviour settings for learning in an environment that provided few 'environmental cues' (Barker, 1968) to direct students' activities.

In its original incarnation, teachers described the Hub as "like a gym", and as an "open space that made the kids want to run around". Some teachers suggested that it wasn't simply the overall size of the space that made it problematic. They believed that limited access to resources and the lack of well-defined settings within the space contributed to students finding it difficult to develop an affinity for the learning environment.

Following the refurbishment of the Hub, students recognised the environmental cues associated with particular settings and generally behaved in ways that were in keeping with the settings they occupied. In this way they appropriated settings as they needed them, rearranged furniture items to meet their needs and relocated between settings to pursue different aspects of collaborative, inquiry-based projects.

Across the three sites, access to interconnected learning environments allowed students to participate in activities that may not have been supported by traditional classrooms. For example, they spread sizeable materials, such as newspapers, out on the floor, or relocated to make use of larger tables. The inclusion of readily accessible wet areas at Suburban HS and the Hub at Seaside SC also enabled students to access art and craft resources. The advantage of having access to a range of learning settings was noted by students:

> Here you have 'air to breathe' … being able to move around and do more stuff …There are spaces for multimedia, there are open spaces for physical activity, and there are the more traditional spaces … there is so much you can do compared with our old buildings. (Suburban HS student)

Students' Geographic Freedom and Spatial Preferences

The places students chose to locate themselves had implications for their learning in the eyes of some teachers. For example, a teacher at Inner City PS expressed concern about students' handwriting and the conceptual quality of their work when they chose to locate themselves in 'inappropriate' physical settings. To encourage the 'appropriate' use of space by students, the teachers at Inner City PS integrated discussions about the use of space into their daily practices.

As a result of this dialogue, students tended to make better geographic choices. At Suburban HS, students were asked to plan how, when and where they would work on projects. Such facilitated metacognition regarding the use of space appeared to play an important role in supporting the development of students' environmental competencies (Lackney, 2008) and to empower them as self-directed learners. One student at Suburban HS suggested that, "Here you can learn while having the freedom to move around". While another student commented that:

> It is easy for us to access things like computers, technology and making things, like for models and posters … we can stay in one area and do one thing, while others work [elsewhere] on another thing, and we don't get mixed up. (Suburban HS student)

In addition to the learning opportunities afforded by new environments, the overall comfort that students experienced in these spaces was important to them. During interviews, students made references to features associated with thermal comfort, air quality and light levels, and described these environmental factors as influencing their like or dislike of particular environments or settings. In addition, they suggested that the materials with which they came into contact were important. Many students identified intimate settings as their favoured locations to engage in learning. This information correlated well with observations of their use of space.

Spatial Ownership, Surveillance and the Development of
Constructivist Pedagogies

Spatial ownership and surveillance played key roles in supporting the development of new pedagogical cultures. The shared ownership of space supported democratisation of the learning situation and enabled students to pursue learning activities with greater self-direction. Surveillance by both teachers and students was observed to encourage social cohesion and enable teachers and students to work together collaboratively.

The release of control over students' geographic experiences followed a process in which teachers re-conceptualised how and when learning occurred. Subsequently, this led teachers to gradually adopt new pedagogies that focused more heavily on the 'processes' of learning rather than on the 'products' of learning (such as completed assessment tasks). As teachers' perceptions changed, they began to see the potential benefits that greater geographic freedom could bring to the learning situation. In particular, they recognised that allowing students to decide where, and often with whom, they engaged in learning led to students taking greater responsibility for their own learning. An Assistant Principal at Suburban HS commented:

> We have had to learn to use the spaces. There has been a continuum from past pedagogy to the current pedagogical practices. As the teachers become more comfortable they allow for a greater variety of activities to occur in the spaces

> … Students are learning to use the spaces independently in ways not intended by the teachers. Students use the space in spontaneous ways that are developed from their natural ways of learning. Really good sensitivity to the concepts and theories of learning is required to understand what is going on upstairs— where the learning spaces allow for freedom and choice of environment and resources. The new learning spaces invite choice, rather than a traditional classroom that required continuous decisions to be made [by teachers] before activity was initiated.

The release of teacher control over students' geographies provided further evidence that the new architecture and the educational theory that had informed the spatial and pedagogical projects in the case study schools challenged teachers to re-evaluate their roles and their practices.

Across the case study schools, students and teachers expressed ownership over their learning environments through their movement of furniture and their appropriation of spatial settings. The degree to which school communities also shared ownership of space was a significant factor in the development of new pedagogical approaches. In situations where ownership of space was not shared, the development of new pedagogies was hindered.

Time was also found to be a factor that influenced both teachers' and students' expressions of spatial ownership. The amount of time that students and teachers spent within particular learning environments influenced their affinity for particular physical settings and their abilities to utilise these spaces effectively. At Suburban HS and Inner City PS the same student and teacher cohorts occupied the same learning environments for the majority of each school day.

This enabled them to develop good understandings of their environments and a shared sense of ownership. At Seaside SC, however, student and teacher cohorts only occupied the Hub for approximately four hours per week. This situation created limited opportunities for students and teachers to develop a shared understanding of the physical and social aspects of the Hub. This demonstrated that students and teachers required consistent access to innovative learning environments if they were to develop ownership over these spaces and become adept users of these spaces as sites for constructivist learning.

Improved social cohesion appeared to be generated when teachers and students engaged in ongoing discourse regarding the expected norms of behaviour that were associated with the use of space, and subsequently when both teachers and students engaged in acts of discipline and surveillance.

This demonstrated that 'power-knowledge' did not emanate from simple centres (the teachers in this case), but was networked throughout these social bodies via diverse relationships (Hirst, 2005). Such networking across these learning communities aided the development of new socio-pedagogical cultures that exhibited democratic qualities. In turn, this democratisation appeared to support student participation in constructivist learning activities.

Two New Constructs Found at the Intersection of Space and Learning

In keeping with the findings reported above, two new constructs were found at the intersection of space and learning: 'reflexive learning environments' and 'student geographical engagement'. These are introduced below.

Reflexive Learning Environments

The teaching and learning behaviours observed in the case study schools indicated that middle years' learning environments should be designed with the express intention of supporting a variety of pedagogical encounters and greater geographic freedom than is afforded in traditional classrooms. Furthermore, the findings indicated that learning environments should be characterised by a reflexive quality if they are to support the complex interactions associated with learner-centred and constructivist middle years' education models.

'Reflexivity' is different to 'flexibility' – a term that is widely used by educators and architects to describe spaces that are intended to cater to a variety of learning experiences (Woodman, 2011). As conceptualised here, reflexive spaces are physical environments that both inform pedagogical encounters and are informed by pedagogical encounters via a bi-directional relationship between the physical environment and inhabitants.

While flexible spaces suggest nothing about the role that space can play in informing teachers and students about how they might engage in particular learning activities, reflexive spaces suggest to users how they might participate in activities, while still enabling them to fine tune physical settings to meet their pedagogical needs. While the utility of flexible spaces (too often filled with homogenous mobile furniture) is largely dependent on the environmental competencies of users (Lackney, 2008), reflexive spaces encourage a range of pedagogical encounters by providing teachers and students with environmental cues that support their mastery of the use of space.

Student Geographical Engagement

The study showed that the design of the physical learning environment influenced student engagement. Indeed, high levels of engagement were supported by spaces that afforded:

• Opportunities for students to engage in a diverse range of activities/pedagogical encounters;
• Opportunities for flexible grouping arrangements that offered students regular transition between working on their own and as members of various sized groups; and
• Student access to a variety of learning resources and materials, including ICT.

It is suggested here that 'geographical engagement' should be considered an important sub-type of the 'student engagement' construct, along with behavioural, emotional and cognitive engagement (Fredricks, Blumenfeld, & Paris, 2004). Geographical engagement was associated with students' affinity for their surroundings, the sense of place they feel in connection with their school learning environments, and their ownership and mastery of their environment (including material and technological resources).

Observations in the case study schools revealed that geographical engagement was expressed by students in the ways they socially produced space (McGregor, 2004b) in support of their learning activities and by their ability to participate in learning activities with some autonomy. The majority of students developed reasonably high levels of geographical engagement following a short period of adjusting to new environments and social programs. For the majority of students, liberation from traditional classroom settings empowered them to take on more responsibility for their learning.

Subsequently, the relative success they experienced as self-directed learners appeared to be correlated with their levels of geographical engagement. The students who gained most from complex interactions with other people, their environment and technology were those who developed an affinity for their environment and were therefore able to make good use of the learning resources available to them. Additionally, high levels of geographical engagement were correlated with the ability of students' to show initiative and work with a high degree of independence from teachers.

CONCLUSION

The disruption caused by the creation of the new learning environments in the case study schools created opportunities for new practices and behaviours to emerge. In response to Elmore's suggestion that powerful pervading cultures in schools often act to maintain the status quo and negate systemic change (Fullan, Hill, & Crevola, 2007), it is the contention of this author that these cultures are embodied in the built pedagogy (Monahan, 2002, 2005) of traditional classrooms and that such cultures may be altered by changing the design and subsequent socio-spatial contexts in schools. The study demonstrated that if teaching and learning conditions are to be improved, educational reform agendas should include changes to the built environment.

The study showed that carefully considered and innovatively designed learning environments could catalyse changes to socio-pedagogical cultures, support the adoption of constructivist pedagogies, and encourage higher levels of student engagement. The findings also clearly indicated that teachers require ongoing professional learning support if they are to adopt constructivist pedagogies and make the most of innovatively designed learning environments. A combination of external professional development seminars and regular internal learning opportunities

which expose teachers to contemporary educational theory, address new spatial usage schemas and provide opportunities for reflection on past and current practices appears to be necessary.

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3. RE-PLACING FLEXIBILITY

Flexibility in Learning Spaces and Learning

INTRODUCTION

> The need for flexible solutions in school design is almost a mantra in the history of education.
>
> <div align="right">Burke and Grosvenor (2008)</div>

Architecture and education are entwined. The recent resurgence of constructivist, student-centred learning has driven a renewed desire for flexible learning spaces. However, a clear and concise understanding of the meaning and aim of flexibility is elusive, both within and between the educational and architectural professions. The term flexibility is, simply put, flexible. This chapter summarises the dissertation that aimed to unravel the knot that is flexibility and to answer the primary question: *How does flexibility in learning spaces affect learning?*

LEARNING

Over the past two decades there has been a move in education away from traditional, teacher-directed, instructionist teaching toward progressive, student-centred, constructivist learning (Duffy & Tobias, 2009). Constructivism is founded in the works of educational thinkers such as Rousseau (1762/1962), Dewey (1916), Piaget (1963), Vygotsky (1935/1994), Bruner (1961), Montessori (1966), and Freire (1970). Constructivists are not bound by didactic "truths" and reject the notion of the teacher being the source of all knowledge, filling the empty student vessels.

In reviewing constructivism, Schunk (2008) noted that students are motivated through the process of learning by following their own interests, and that they assess their learning by setting their own targets, monitoring their own progress, and completing self-evaluations. Individual students are supported through this process by teachers, from across various disciplines, who provide a framework to assist students to go beyond blockage points in their learning.

A recent development in constructivist thinking has been referred to as "heutagogy" by the educationalists Hase and Kenyon (2000, 2007). These authors suggested that in a pedagogic relationship the teacher decides what the student is going to learn and how the learning is to be undertaken. Even in progressive pedagogies, this relationship only allows students to be self-directed in their

learning as they still follow a path established by the teacher. Hase and Kenyon developed the term heutagogy, with "heuta" meaning self in Greek, to describe a self-determined learning based on ideas generated through an interaction with the environment.

In their view student-determined learning creates capable rather than competent individuals who can reflectively respond to new stimuli in new situations rather than being restricted to linear rote reactions to stock situations. Hase and Kenyon promote an action research approach to learning that develops self-efficacy in new learning challenges. They argue that modern workplaces are constantly evolving and require capable individuals who can adapt to changing situations.

Constructivism has its roots in the relationship between the learners and their environment. The place of learning, the surrounding, the setting, the situation, and the social all interact with the learner to produce constructions of understandings. Dewey (1938–1939) suggested that learning ideally occurs in locations where the environment challenges pre-constructed understandings. He promoted learning through activity based "situations":

> The conceptions of *situation* and of *interaction* are inseparable from each other. An experience is always what it is because of a transaction taking place between an individual and what, at the time, constitutes his environment. (Dewey, 1938–1939, p. lw. 13.25, author's italics)

For Vygotsky (1935/1994) the environment was the basis for, and cause of, all human cognitive growth. He wrote that, "… environment is the source of development and not its setting" (p. 349). However, Vygotsky saw the environment not as "something absolutely hardened, inflexible, and unchanged" (1926/1997, p. 53) but as a plastic arrangement of elements that could be manipulated by the learner. He believed that the environment was "very nearly the most flexible of all tools of education" (p. 54).

As well as arguing for situated constructivist learning, Dewey (1938–1939) suggested that the learner physical movement was a prerequisite for learning. He promoted learner freedom as a combination of both external and internal activities. External activity refers to physical activity where "…freedom of outward action is a means to freedom of judgement and of power to carry deliberately chosen ends into execution" (p. lw. 13.41). Where, internal activity relates to thinking, motivation, and desires. External activity cannot be achieved without internal activity such that the mind and body transact.

Similar to Dewey's notion of freedom, Montessori (1966) believed that movement provided opportunities for contact with external reality which, in turn, provides for the creation of abstract ideas: "Physical activity connects the spirit with the world, but spirit has need of action in a twofold sense, to acquire concepts and to express itself exteriorly" (p. 97). Movement for Montessori was guided by the student's inner reason based on reflection and self-control. This purposeful movement provides opportunities for focus and fascination in learning.

LEARNING SPACES

The word classroom, or "class-room", relates directly to the traditional pedagogy of teacher-directed teaching of a social "class" of children (Beare, 2001). New terminology has developed to reflect more student-directed environments with "learning spaces" becoming the preferred term turning the focus onto learning rather than teaching. The moving debates on space and, by association, place (see for example Cresswell, 2004; Dovey, 2010; Lefebvre, 1974; Massey, 2005) may influence the understanding of learning spaces.

The notion of space was explored by the German existential phenomenologist Heidegger (1969, 1971). For him, humans are essentially spatial beings and space is where we exist or dwell. Inherent to human beings as dwellers, space is a location with boundaries that is created rather than limited through the removal of place. This is a notion of space that is vacant, an empty vessel or supporting structure within which life provides attachments by making boundaries around places (Sharr, 2007).

However, space is no longer considered an empty vessel awaiting filling but "a (social) product" (Lefebvre, 1974, p. 26). This approach has similarities to traditional pedagogies described earlier where students are considered empty vessels awaiting filling with knowledge by teachers. Lefebvre's understanding of space reveals a means of control and power. The renaming of classrooms to learning spaces may invite the transfer of power from teaching to learning, from teachers to students.

This understanding of space has been developed further by Massey (2005), who described space as a "production of interrelations" as a "sphere in which distinct trajectories coexist" and always "under construction" (all Massey, 2005, p. 9). The similarities of these propositions with those of educational constructivism are clear. Massey portrayed trajectories in terms of a process of change and movement, which have strong connections with flexibility. Trajectories hold a role in Massey's understanding of place as an "ever-shifting constellation of trajectories" (2005, p. 151).

For her, place is temporarily created and maintained as a result of the paths of the passing actors. Taking a different approach to the notion of place, Dovey (2010) preferred to base his work on the Deleuzian (1987) concepts of becoming, desire, and assemblages, arguing that "all places are assemblages" (2010, p. 16). Using de Landa's (2006) examination of assemblage theory, Dovey described places as always in development, dynamic, a reflection of constant changes in desire, and a "state of affairs" (2010, p. 16). The theoretical space and place tools of social construction and assemblage can be brought to bear on learning spaces to reveal power relations, interrelations, and the flows of desire.

Like Lefebvre, Foucault (1979, 1997) linked space both to the social and to power, writing that: "Space is fundamental in any form of communal life; space is fundamental in any exercise of power" (1997, p. 376). A short time after Lefebvre's work on the social production of space, Foucault published his work *Discipline and punish* (1979). This work focused on the birth of prisons, but more generally reveals

the effects of power on space. Foucault noted that discipline started in secondary schools and spread to other institutions such as primary schools, hospitals, and the military. For him, discipline created regimented, docile bodies with little will that "proceeds from the distribution of individuals in space" (1979, p. 141).

He suggested that discipline requires the enclosure not of just space, but of a uniform, repetitive, monotonous space. Further, the disciplining of space relied on the physical isolation of individuals within the space which is traditionally undertaken through creating individual cells. Student use of these disciplined school spaces was defined and restricted with a rigid ranking system.

This framework was set within the limit of compartmentalised time framed in a school timetable. The architecture that produced this form of discipline, according to Foucault, was not confining and closed, but transparent and open where surveillance provided control over the students. Control was not limited to the architecture, with a system of student monitors providing a hierarchical method of surveillance back to the schoolmasters.

Focussing on the architecture of surveillance, Foucault considered the penitentiary panopticon designed by Bentham as an ideal model. By using a darkened observation tower in the centre of a surrounding ring of backlit cells the guards had implicit surveillance over the inmates regardless of the guards' actual presence, thus assuring "the automatic functioning of power" (p. 201). Foucault saw this idealised form of discipline surveillance as having spread throughout society and particularly within schools which he noted resembles prison.

Foucault (1979) described classrooms as places of power, discipline, control, and as a "pedagogical machine" (p. 172) where surveillance enforces student study. For him,

> Surveillance, defined and regulated, is inscribed at the heart of the practice of teaching, not as an additional or adjacent part, but as a mechanism that is inherent to it. (Foucault, 1979, p. 176)

Foucaultian practices of spatial organisation and control may be preventing progressive pedagogies from taking hold in the classroom. Flexibility may play a part in the mediation of power and the expression of desire when assembling a learning place.

In conjunction to the theories of space and place the relationship between human behaviour and the environment was explored within the field of environmental psychology. This relationship was considered a transactional one where each affects the other (Fisher, Bell, & Baum, 1984, p. 6). Several theories of the human-environment transaction are presented below to provide a range of tools with which to subsequently analyse learning spaces and the transaction with students or teachers.

First, is the notion of behaviour settings developed by Barker (1968). He established that groups of people were triggered by cultural cues to behave in similar ways in similar physical settings. Although the behaviours were not completely uniform across each setting, they were sufficiently similar to suggest a pattern within

each distinct setting. Behaviour settings do not exist as a result of the environment alone, but require the interaction of the participants within the environment.

So, if the participants are absent from the setting only the physical milieu would remain. Further, without sufficient physical cues the behaviour setting could become confusing. Fisher, Bell, and Baum (1984), for example, noted that open-plan classrooms can often create confused behaviour due to a lack of physical boundaries between settings.

The notion of affordances was developed by Gibson (1977) and is some ways similar to Barker's behaviour settings. Gibson proposed that the environment offers opportunities for use by humans and that these opportunities, or affordances, vary depending on how people perceive the environment as a result of their needs. He noted that usually an individual does not perceive the properties of the environment but what it can afford. Also, if an object becomes moveable there is a significant increase in the variety of affordances available to the individual.

The notion of adaptation was presented by Ittelson, Proshansky, Rivlin, and Winkel (1974) who noted that generally people take familiar physical surroundings for granted and, as a result, have little desire to change them. However, interestingly and counter to the social view of space, Ittelson et al. noted that: "Environments are typically neutral. We are most aware of their characteristics when change is introduced or when we encounter an unfamiliar setting" (p. 96).

This would reinforce the notion that it is the active transaction between the learner and the learning spaces that supports learning. Further, when the environment is changed or an unfamiliar setting is encountered there is a heightened awareness of the setting and its possibilities.

Following an extensive exploration of the new environment, individuals are able to manipulate or adapt it to suit their needs. Meaning and significance can be applied to a place through the adaptation of an environment to satisfy the specific needs. This is referred to as appropriation (Werner, Altman, & Oxley, 1985). During appropriation an individual may identify with, take control over, care for, feel some belonging to, or apply some meaning to an environment and in some way become attached to the place.

During adaptation and subsequent appropriation of the environment there is a transactional effect on the person that changes the attitude of that person towards the environment. This suggests a sense of some ownership and value that further implies notions of territorial control and acts of privacy. Different from the Deleuzian assemblage concept of territorialisation, Altman (1975) introduced the environmental psychology concepts of territoriality and privacy. Territoriality implies a temporary or permanent ownership of a space by an individual or group. The space may be occupied or not, but the territory is likely to be marked with explicit or implicit signs and symbols.

The territory is generally defended, but at times may be ceded to a more powerful entity. The notion of privacy refers to the culturally accepted level of access to individuals or groups. It is not a set measurement, but varies across different

groupings with the extent of private space often being marked through territories. The level of privacy is controlled by power and status and is regulated verbally, nonverbally, physically, and culturally.

FLEXIBILITY

Flexible: able to bend without breaking; pliable; pliant; easily led: manageable; docile; adaptable; versatile; variable. (Oxford University Press, 1995)

The diverse needs of constructivist learning have resulted in the recent, constant and widespread call for flexible learning spaces (see for example British Council of School Environments, 2006; Commission for Architecture and the Built Environment, 2002; Council of Educational Facility Planners International, 2009; Futurelab, 2006; JISC, 2007; OECD The Programme on Educational Building, 2001; Victorian State Government, 2008). The spatial responses to these calls for flexibility have been varied, broad and rarely catalogued.

Flexibility has developed to incorporate a range of solutions including operable walls and sliding doors, moveable furniture and transformable fittings, open fluid spaces and purposeful settings, learning streets, and multi-functional areas (see for example Burke & Grosvenor, 2008; Commission for Architecture and the Built Environment, 2006; Dudek, 2000; OECD The Programme on Educational Building, 2006). This has been accompanied by an equally wide and varied understanding of the term flexibility.

A review of the literature provided a broad and extensive view of flexibility. It is not a term that is clearly defined and succinct. Thus, the homogeneous, cover-all term of flexibility required disassembling. To clarify the term of flexibility I have produced the diagrammatic representation shown in Figure 1. A range of facets of flexibility can be established from the terms in the literature associated with flexibility. From a review of the definitions and use of the term, flexibility can then be divided into four main categories of change: time, space, use, and movement as follows:

- *Time flexibility* relates to the ability of a structure to change over an extended period of time to satisfy significant changes in need.
- *Space flexibility* relates to the manipulation of elements to create different spatial arrangements and could be described as a transformational type of change.
- *Use flexibility* relates to changing the use of a space without altering the space itself. This change could be to permit different pedagogical activities to be undertaken within the same space.
- *Movement flexibility* relates to the movement of students, teachers, and others within and around the learning space.

A flexibility taxonomy can be created when the four categories of time, space, use, and movement are applied over the facets of flexibility. Figure 1 presents this

taxonomy and demonstrates how each of the facets can be allocated to one or several of the categories.
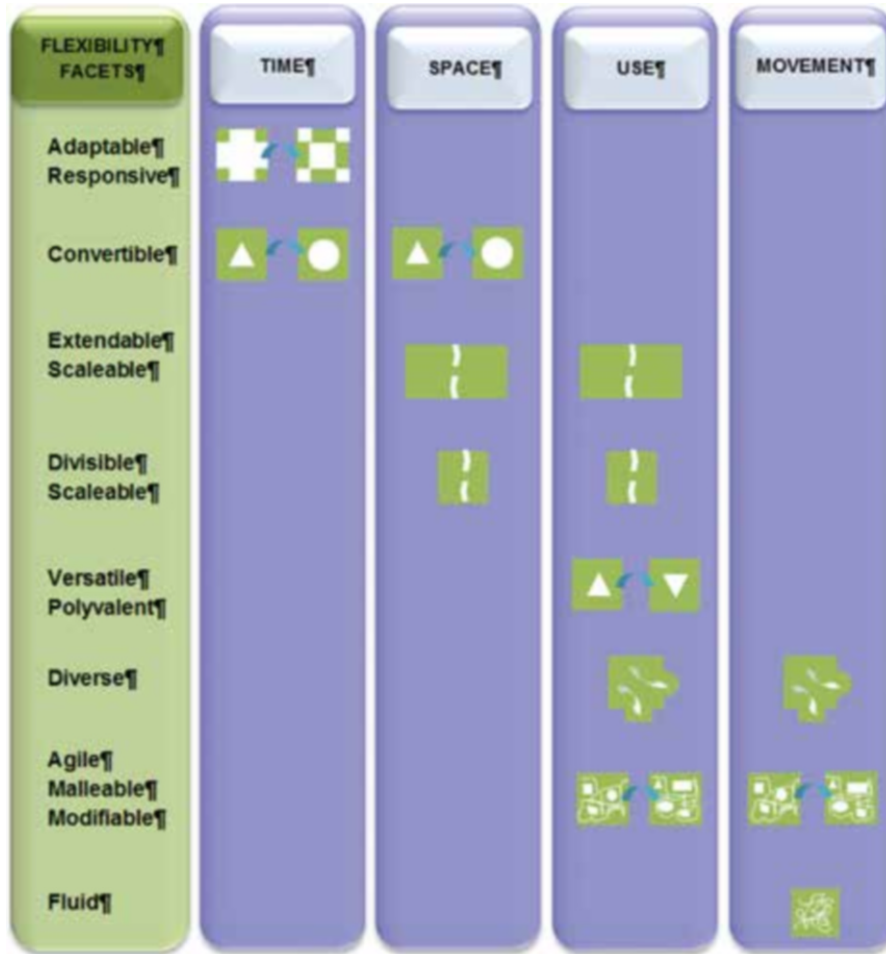
Figure 1. Taxonomy of flexibility

METHODOLOGY

The theoretical positioning of this study was based on constructionist ontology with an interpretivist perspective (Bryman, 2004). From within this approach part of the study was undertaken from a critical social science position (Neuman, 2007).

The study has a qualitative research strategy (Denzin & Lincoln, 2000) with inductive and iterative approaches (Lather, 1986; Walter, 2006). Finally,

actor-network theory (Callon, 1986; Latour, 2005; Law, 1992) is employed as a theoretical tool for studying the complex relationship between the individual and the environment.

The basic premise of Actor-network theory, referred to as ANT, is that the "social" is not a domain among others such as economics, geography, and psychology, but it comprises the connections between domains. In ANT, the actors in society are considered to be both human and non-human entities. Both these entities have the potential for agency and act upon each other creating and recreating groupings. Through this view, space can be considered as having an influence.

A single case of a secondary school in regional Victoria, Australia, was selected to provide an in depth, rich study into flexibility. A range of variables were studied in the school with age groupings from Years 7 to 11, learning spaces from traditional classrooms to open spaces, and different teachers employing various pedagogies within those spaces. The observations were grouped into pedagogical approaches with a traditional teacher directed pedagogical method observed in three spaces, a progressive blend of teacher and student-directed pedagogical method in a three other spaces, and a student-determined heutagogical method in one further space. A non-random strategy of sampling was used to select teachers through volunteer, deliberative, and snowball selection.

A multi-method approach was adopted (Hunter & Brewer, 2003) that included semi-structured interviews of students and teachers (Zeisel, 1981), spatial mapping of the learning spaces (Horne, 1999), a participatory action research process (Kemmis & McTaggart, 2000) with Year 9 students, and reflective interviews with the teachers.

The spatial mapping involved observing the same learning space for 100 minutes periodically over six months and visually tracking the human movements and the spatial changes on a computer. In line with the categories of flexibility established above this tracked changes over time during the six months. The spatial changes that had occurred between observations within the space were recorded. During the 100 minutes sessions the movement of furniture and any other spatial item was recorded. Scott-Weber (2004) determined and defined activities within a classroom as delivering, creating, applying, communicating or decision making. The activity and location within the space was recorded at five minute intervals during the session. Finally, the movement paths were recorded of the teacher and two randomly selected students. The paths were observed and manually recorded on the computer on the learning space floor plan. The teacher was recorded in magenta, the male student in blue, and the female in red (these colours can only be seen in the eBook version). A circle represents a stationary person with the size of the circle directly related to the length of time the person remains in that location.

Further, interviews on the theme of flexibility were undertaken with seven selected teachers, ten students selected by the class teachers, four school architects, and three government and non-government providers of facilities including those involved in the case study school design, all individually selected.

Finally, a Participatory Action Research process was undertaken with Year 9 students in their learning spaces separate from the rest of the school. This heutagogically based learning resulted in the students planning and executing project work within the community. The author worked with six self-selected students to discuss, plan, and physically implement changes in their learning settings. Then, these changes and their effect were reflected on during interviews with the students and teacher.

The analysis of the findings was organised into pedagogical approaches that reflect year groupings. These are the traditional pedagogic approach with the senior Years 10 and 11; the progressive pedagogy with the middle Years 7 and 8; and the heutagogical approach, or student-determined learning, with Year 9.

RE-PLACING FLEXIBILITY

Between Meaning and Meanings

Flexibility is a term that has a meaning that is neither static nor fixed. Although dictionaries provide definitions for flexibility that relate to things that are pliable and bendable without breaking, a review of the literature provided a wide and varied range of understandings. The confusion in the literature mirrors a confused understanding about flexibility in the fields of education and architecture. There is no single clear meaning for the term, and it is being constructed and re-constructed.

The findings from interviews with facilities providers, architects, teachers, and students also revealed a range of meanings rather than one meaning. Using the categories of time, space, use, and movement, it became clear that the groups involved in the design and use of learning spaces had understandings that were not aligned but varied across the categories.

Figure 2 provides the pictorial representation of the meanings of flexibility. The shading within the interviewee bars is a representation of the main focus of the responses. The figure indicates the area of most responses with a darker area of shading. Thus, although there were some references to other categories, facilities providers' main focus during the interviews was on time; architects' on space; teachers' on use; and students' on movement.

This confusion has the potential to cause misunderstandings and misinterpretations among the participants as each of them construct their own meanings through their own experiences. Thus, one single meaning for the term flexibility is not sufficient in the literature and in practice. Flexibility has a multiplicity of meanings which, when used, require specific clarification through the question: "What do you mean when you say flexibility?"

This variety of meanings requires some "re-placing" of the term flexibility. The term as it stands is useful as a collective word, but some sub-categories of flexibility may assist for clarification. For the *time* related flexibility, the term *adaptability* may be used as low magnitude/high frequency architectural change. Where flexibility is related to *space,* the term *transformability* may be employed as the ability to change
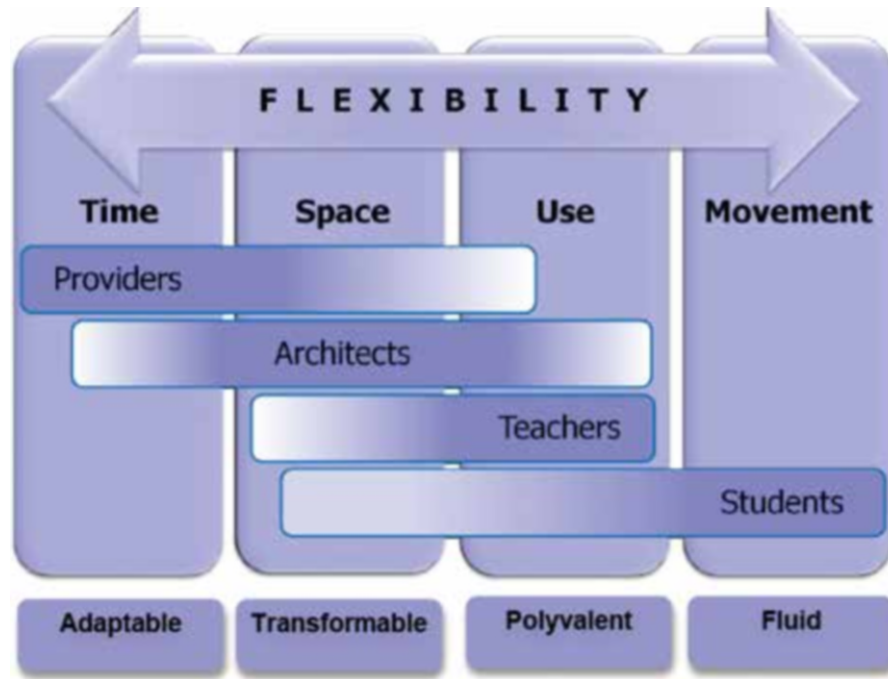
Figure 2. Pictorial representation of the meanings of flexibility

a space from one form to another in a way that would require some effort. The *use* flexibility could be re-placed with *polyvalent*. This term, adopted from chemistry by the architect Hertzberger (2005), describes a space that can be pedagogically used in a variety of ways without the form itself having to change. Finally, for the *movement* flexibility the word *fluidity* may be appropriate for describing a space that supports the free movement of teachers and students within a learning space. These terms are not to remove the term flexibility but to "re-place" it with the support of more explicit terms that can eliminate the conflict that is arising from its sole and exclusive use.

For clarity, the findings from the empirical study have been incorporated into the discussion as below.

Between Rigid and Transformable

The body of theory and knowledge connects constructivist learning to the environment (for example see Dewey, 1938–1939; Vygotsky, 1935/1994). However, the literature indicated that the environment is not just a backdrop, a shell, or a simple enclosure. It is the interaction, transaction, and manipulation of the environment

that causes learning. When looking at the space mapping as a whole across all the observations undertaken it was apparent that the learning environments were not altered significantly during the learning sessions. There were some sessions where spatial movement did occur, such as the space used by a progressive pedagogical Year 7 group, as shown in Figure 3, but generally the spaces changed little during the 100 minutes sessions.

0 to 10 minutes

10 to 55 minutes

55 to 65 minutes

65 to 100 minutes

Figure 3. Changes to arrangements within one 100 minutes observation Year 7 Engineering

This lack of spatial change was regardless of the pedagogical approach of the teacher, as demonstrated by a student-determined heutagogical Year 9 space that changed little during the observation sessions. The student manipulation of the learning environment was not apparent with students making few changes to their spaces. The students did not interact with their environment by changing the space to suit their learning needs.

A transaction did not occur in terms of the students impacting on their learning space and the environment impacting on them. Actually, quite the reverse was

happening, as the rigid environment caused the individuals to alter their learning needs to accommodate less than satisfactory spatial arrangements. An example of this was demonstrated in the Year 10 sessions. The students attempted to work in groups and were hindered by the spatial arrangement of the horseshoe of tables as shown in the 75 to 85 minute period of Figure 4.

Dominant Pedagogic Activities: DE = Delivering; CO = Communicating; CR = Creating; AP = Applying; DM = Decision Making

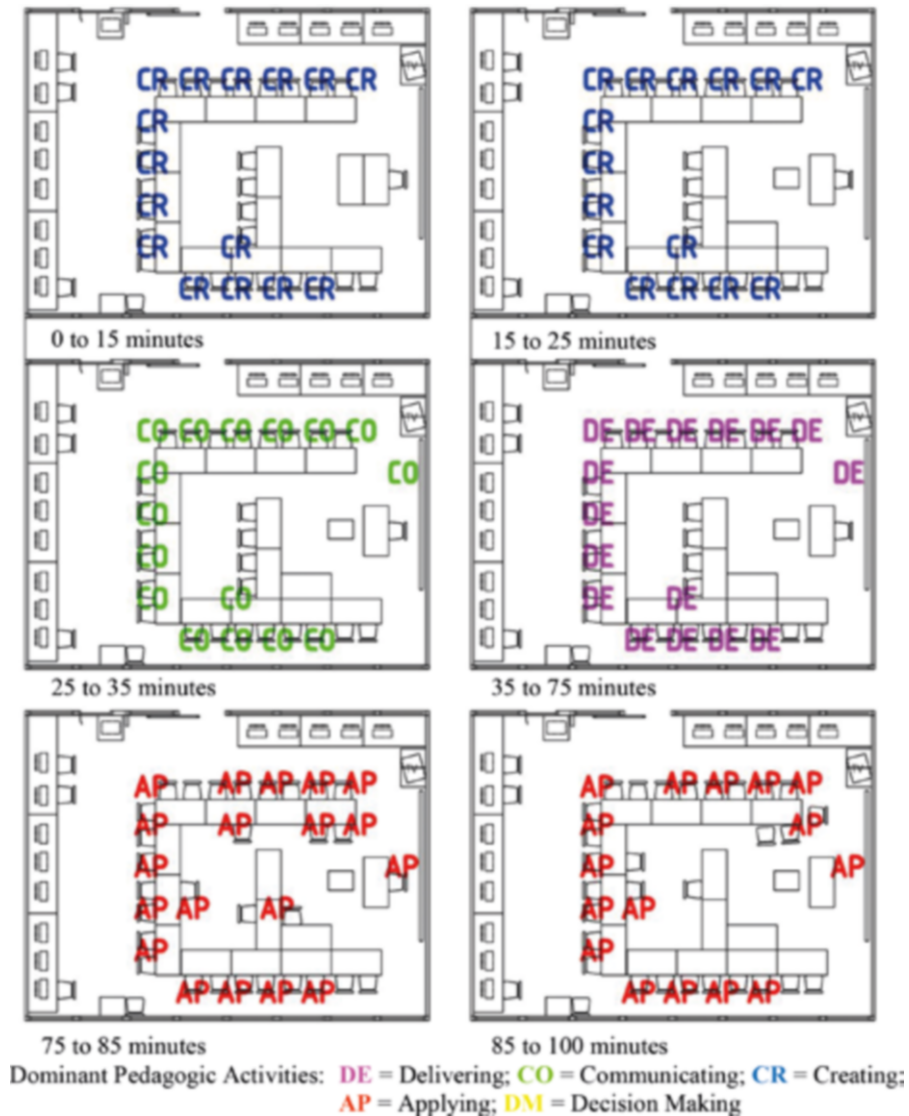*Figure 4. Changes in use during a teacher-directed pedagogic Year 10 English session*

In the interviews some teachers expressed a desire to let students have some control over their space and over flexibility. However, that independent student manipulation of the learning space did not occur during the observed learning sessions. The observed spaces generally remained rigid and unchanged despite some of those spaces having being specifically designed to facilitate flexibility. As a result of this rigid internal layout, it was the students themselves who became masters of flexibility in that they were required to undertake a range of pedagogical activities without changing spatial arrangements. The rigid spaces created and were supported by flexible practices.

This was demonstrated in the use mapping where often a variety of pedagogical uses were undertaken within the same spatial arrangement. Again, the spaces impacted on the individuals rather than a transaction occurring. In this way the spaces did have polyvalent properties in that they permitted a range of activities without the spaces being changed. However, in these situations the spaces were succumbing to the different uses rather than supporting a range of learning processes and needs.

Thus, the current learning spaces at the case study school remained rigid and unchanging despite the opportunity for spatial reorganisation. The type of learning space did not make any difference to this rigidity as the lack of flexibility occurred in traditional classrooms, double portable spaces, open learning spaces, and in a new senior building designed with flexibility in mind.

The only observation sessions that were different to this were in Year 7 Engineering where the teacher created some limited spatial changes to satisfy her needs for a variety of activities. This study demonstrated that, despite the importance that the literature placed in an interaction or transaction between the learner and their environment, student spatial transformations of the learning environment did not generally occur in the case study school.

Between Static and Fluid

Writers in the literature argued that learning is supported by physical human movement (for example see Dewey, 1897; Montessori, 1966). They suggested that free, purposeful movement provided learning opportunities and a student focus. There are connections in the brain between cognition and movement (Jensen, 2000). A positive relationship was made between physical activity and academic achievement, while physical inactivity was negatively associated with brain activity.

The mapping in this study showed that there is a link between pedagogical approach and student movement. Students in traditional teacher-directed learning environments are typically static and immobile. Heutagogical student-determined learning took place in a highly fluid environment such as the Year 9 learning space with the exception of relatively static students who are engaged in their learning. Some students were extremely active and covered as much ground as their teacher during any session. In contrast to this, the Year 10 and 11 sessions were dominated

by traditional didactic teaching where, often, the teachers were extremely active and the students were inert for 100 minutes.

This situation was the result of the pedagogical approach rather than any restriction on space, as demonstrated by the lack of student movement in a Year 11 Physical Education sessions shown in Figure 5 where the magenta line is the path of the teacher, red is a female student, blue is a male student (these colours can only be seen in the version of eBook).
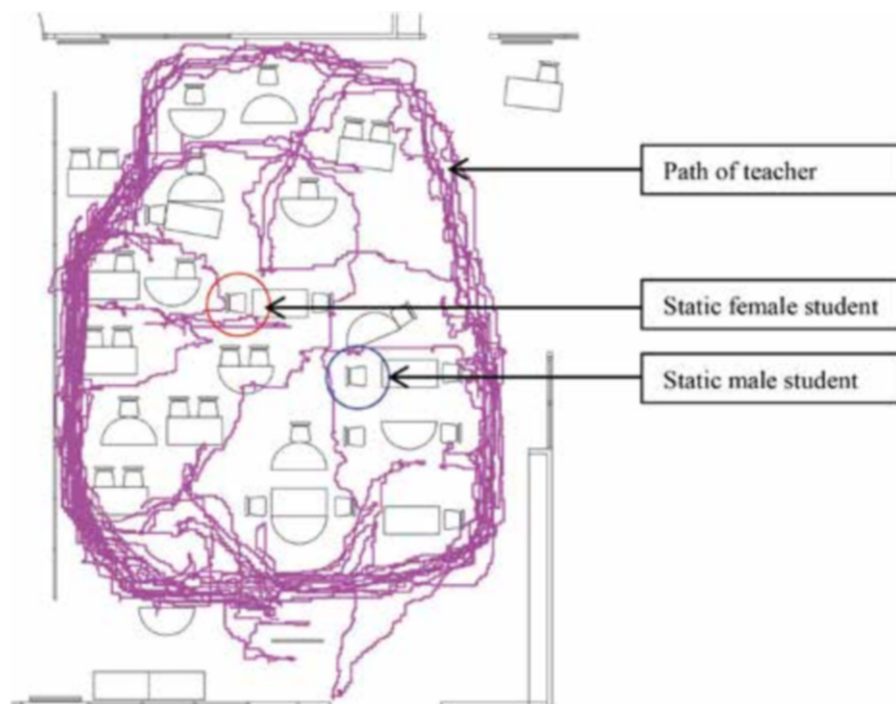
Figure 5. Movement paths in a teacher-directed pedagogy session during
100 minutes of Year 11 physical education period

The issue of movement is further highlighted when it was discussed with the students during the interviews. The students expressed an explicit desire to move during their learning. They saw movement not as an issue of behaviour but as an opportunity for learning. Social contact was important for them but, with an unknowing support for the social constructivism of Vygotsky (1935/1994), they saw the need to interact with their peers in developing their understandings and knowledge.

For the students, interaction was in part socialisation in that they wanted to interact with their friends, but they also noted the learning opportunities of looking

for inspiration, testing their own understandings, and challenging their propositions. They felt that the loss of concentration through movement during learning would be significantly less than the loss of concentration due to sitting in one seat and "zoning out".

In addition, many of the teachers were unaware of the lack of student movement in their sessions. Once the movement mapping was presented to the teachers some were so concerned that they actively changed their future practice. However, the general blindness to the mobility of students meant that opportunities for student interaction were missed. This was articulated by a Year 9 student when he said that it was difficult to interact in a group when sitting in a horseshoe formation.

Movement in the learning space has traditionally been seen as a behavioural issue. Some teachers saw student movement in terms of a loss of control. In contrast, some of the interviewed students indicated that had they been offered the opportunity to be more mobile in their learning they would have respected and acted on that responsibility.

Clearly, there was a significant tension between the theories about learning and movement compared to the current practice in the case study school. Students in traditional teacher-directed space shown on Figure 5 and progressive student-directed learning environments shown on Figure 6 were not moving as much as students in heutagogical student-determined environments which can be seen later in this chapter in Figure 10. Without such movement, students are missing the opportunities to engage in socially interactive learning.

Between Territoriality and De-territorialisation

A variety of human-environment transactional theories including behaviour settings (Barker, 1968), affordances (Gibson, 1977), appropriation (Werner, Altman, & Oxley, 1985), privacy, and territory (Altman, 1975) are all useful when analysing the environmental psychology of learning spaces. The behaviour setting of the learning environment was clearly in place across the case study. The teacher-student-learning setting triangle was evident as all played their part as actors in the behaviour setting of a learning environment.

A traditional classroom behaviour setting was strong in the more traditional teacher-directed pedagogical situations. However, the traditional learning setting was challenged in some of the circumstances. The Year 8 learning space in Figure 6 was sufficiently large to create a range of different settings including areas for group tables, presentations, and individual learning. As a result, the behaviour settings of the traditional classroom were dispersed. This required the students to be more mobile or fluid to access the setting that suited their specific learning behaviour at any point.

The affordances that the Year 8 learning space created were wide and varied in comparison to the fixed arrangements of the Year 10 traditional classroom and the Year 11 single classroom space. The former provided a range of affordances that supported a range of pedagogical approaches including student-directed learning,

Figure 6. Movement paths in a student-directed pedagogy session
during Year 8 humanities

whereas the latter two spaces with their static, constricted arrangements afforded only one opportunity, that of teacher-directed didactic teaching.

The Year 8 teacher reinforced this notion when he suggested that the students direct not only their learning, but also their learning spaces.

When changes occur to spaces they become less taken for granted and more visible. This was seen during the Year 9 Participatory Action Research (PAR) process where the author worked with six students to recreate their learning spaces as seen in the original and final plan in Figure 7.

As a result of the PAR work with the students, they became more aware of their spaces and the learning opportunities. These changes brought with them an appropriation of the spaces, initially by the PAR students and then by other Year 9 students. During the PAR process the students took more control and more ownership over their learning spaces to such an extent that one of the teachers felt that she had no right to alter the settings that the students had created. However, the settings created by the PAR students did cause some conflict regarding the concept of privacy. Some of the new settings created levels of student privacy but limited levels of teacher supervision. This tension is discussed below under the heading: Between Control and Freedom.

Territory was an important issue across the learning spaces. Typically, in the learning spaces the students tended to occupy the same desk surrounded by the same group of students every session. This territorial habit was maintained by students and teachers alike.

Students commented that they generally sat in the same location in the learning space. Students liked this territorial approach as it provided them with some ownership over what they regarded as their personal space despite the remainder of the learning space being controlled by the teacher.

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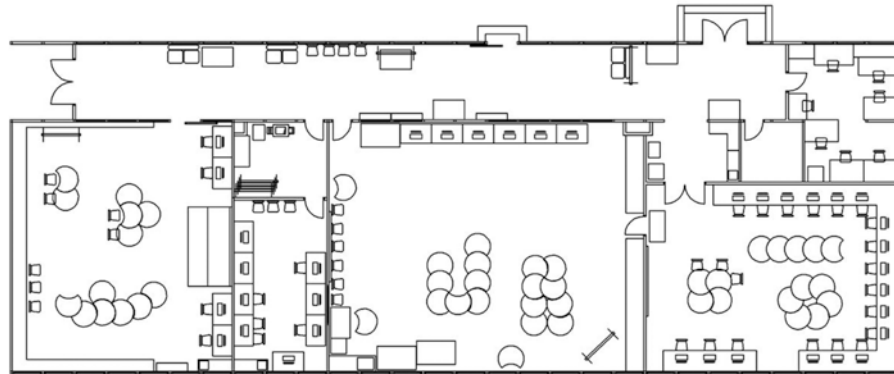
Year 9 Community Learning space: Original plan
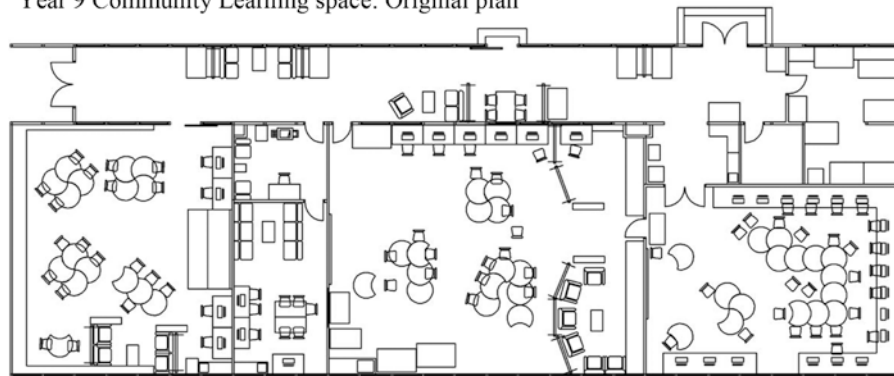
Year 9 Community Learning space: Final plan

Figure 7. Year 9 community learning space original and conglomerate PAR plans

However, this form of territory can be detrimental to learning as was seen when some of the PAR group were occupying a new breakout space that they had created and another Year 9 student was prevented from using the space and retreated with the retort: "You built it, you can have it".

This form of defensive territoriality contrasts with the more creative territorialisation/de-territorialisation dimension of assemblages (Deleuze & Guattari, 1987). The movement towards de-territorialisation was evident with the Year 10 students. These students maintained the robust repetitive practices of attending school and adhering to the lesson timetable. However, they felt no desire to remain in the traditional classroom space that they were taught in. The two interviewed Year 10 students held little attachment to the classroom despite some students' work being displayed on the walls and the horseshoe layout maintained by the teachers to provide opportunities for collective group discussions.

67

Any feelings of territoriality stemmed not from the room as a whole, or from the occupants alone, but from the socio-spatial assemblage of small groups of friends repetitively sitting in the same location each session. This compares with the Year 8 and Year 9 students who also had the same rhythmic school practices but had some influence over the arrangement of their learning spaces.

These students chose where to sit and were at liberty to reorganise the spaces to suit their learning needs, thus causing a social attachment to the place. In this way their territoriality was not only in the ability to sit in the same location if they desired, but bound by a collective ownership and responsibility for the space. Therefore, the desire to learn in that environment created a territorialisation of the place that, in turn, reinforced the desire to learn.

Between Space and Place

The discourse about space with the various concepts of space provided opportunities to view the case study learning spaces in different ways. With a Heidegger (1962) view of space, the small Year 11 Physical Education classroom, when empty of the class, is a bounded, clear, and free space awaiting new occupants. When the room is occupied classroom life is attached to the space in Heidegger's sense of being-in-the-world.

Figure 8. Photographs of portable classroom occupied by Year 7 humanities

Lefebvre (1974) regarded space as socially produced, a means of production, and not found. He offered three concepts of space: spatial practice that was a perceived, coherent, and social space based in society; the dominant representation of space as a conceived, intellectual, and mental space based on language; and the dominated representational space that was a lived, inhabited, but hidden space based on images and symbols. If these are applied to the case study school, a space like the Year 7 Humanities room seen in the photographs of Figure 8 could be seen in each of the three ways.

As spatial practice it would be perceived as a socially constructed environment with the interactions among teachers and students creating a coherent space or a society of learning. In this situation the teacher was delivering a progressive pedagogy where the students had some control over their social interactions and their learning. The representations of space would be based on the language of the space.

This would be the way the teacher conceived of the space during her planning and practice or the way she thought about the space with pre-organised rearrangements such as rows, circle, groups, and the horseshoe arrangement of tables as seen in the third photograph. This creates a conceptual intellectual space and would be dominant over the other two concepts. Finally, the representational space would be the lived experience within the space that delivered the hidden meaning behind the classroom and describes the power structures of teacher, students, and school/ educational authority.

The way the space was used and controlled by the teacher with only a little student independent movement or spatial manipulation, created a space with a reasonable level of inherently authoritarian control. This is borne out in the lack of connection between space and learning reported by the students during the interviews.

Massey (2005) regarded space as being a product of interrelations between heterogeneous trajectories in a sphere of constant change that was always under construction. With Massey's understanding, the case study learning spaces could be seen only as social environments constructed through the interactions of the teacher and students disregarding any physical environment. Thus, if considering this concept of space, any change to the physical space should not make any difference to the social experience within the space. However, the case study demonstrated that teachers elected to change spaces to suit their teaching needs despite still having the same students within the space. Further, when the Year 9 PAR students created new learning settings the space changed for them despite the individuals within the space remaining the same. A Year 9 student commented: "It is amazing what a little bit of difference makes. Like this used to be just a classroom but now, with the [soft] seating area, it feels so different".

In association with space is the notion of place. Heidegger (1971) regarded place as a human emotional attachment through experience to a location set within a space, whereas Massey (2005) considered place to be a process of trajectory collection not bound by location.

69

Dovey (2010) considered place to be between these views that had both spatiality and sociality. He saw places as being always in development, dynamic, and a reflection of constant changes in desires that had intensity and a "feel". For the Year 10 students their traditional classroom was a space with limited emotional attachment, although it provided social contact with the teachers and some limited contact with their fellow students.

It satisfied the pedagogical requirements of the teacher with the horseshoe seating format and a row of computers, see Figure 4 above. However, for the students there was no desire to be in the space; it had no intensity, and no feel. The students were not connected to that space in any way and they could have been taught to the same extent in the adjacent classroom space. Similarly, the Year 9 PAR students felt no positive connection with their buildings originally. They spent the first meeting with me highlighting the bad things about their buildings. It was not until they assembled their own place through their own desire, social interactions, and transformation of the space that the space turned into a place for them.

Their connection to it, their respect for it, and even their acknowledgement of it were evident as the project continued. Their intensity and feel remained until they left the campus whereupon the place they had created became unstable and lost the repetitive practices that maintained them. The next set of students took on the challenge to develop their own learning place with desire, emotional connection, and territoriality with intensity and a "feel".

The PAR students' connection to both spatiality and sociality was evident as they manipulated spaces to suit their needs. Their desire to work on their learning spaces was apparent in their continued association with the volunteer process throughout the term and in defending those spaces when challenged. The pride they displayed in their spaces was clear in a wish to present their project to parents at the end of term.

Also, the social connection they made with each other and with me was obvious as they fully supported each other during the process. Further, the social connection with others at the campus was apparent in their willingness to undertake the project for all the Year 9 students, as displayed in one comment: "We have done it but we have done it for everyone. We haven't done it for us. It is still there for them to use. That's why we've done it".

This raises a different understanding of the notion of ownership. For many of the teachers, ownership meant the personalisation of a space through the presentation of student displays. This may have some benefit and provide some connection, but for students the personalisation of a space though their own action appears to have created a much stronger bond with a place. The socio-spatial acts of transforming the learning spaces developed a sense of ownership in them. The Year 7 Humanities students felt little ownership over their space despite there being posters and their own work on the walls.

However, the Year 8 students did feel connected with their learning space as a result of being able to move within that space and change it physically. The Year 11

students held a strong connection to their space even though there were no displays of their work on the walls. For them, their feeling of ownership developed from having most of their lessons in that space and some sense of control over it. Horne Martin (2002) suggested that student participation in the design and construction of a space increases a sense of ownership that improves management and maintenance issues while reducing vandalism and neglect.

The participatory process with the Year 9 students demonstrated that if students are part of the daily practices of considering and changing their learning spaces there is a powerful feeling of ownership and connection. The Year 9 PAR students reported that the intensity of the connection to place created positive attitudes towards learning. Thus, flexibility could be regarded as a catalytic socio-spatial assemblage that positively affects students' attitudes towards learning.

Between Discourse and Practice

As discussed above the theoretical connection between learning and the environment found in the literature are described. The majority of the teachers interviewed indicated that space was important for learning. The only teacher who stated that space did not make much of a difference to learning changed his opinion during a reflection interview process.

The acknowledgement of space as an actor in learning was in line with actor-network theory which suggests that non-human elements have agency similar to humans (see Latour, 2005). The teachers' discourse contrasted starkly with their practice because the mapping revealed a lack of spatial manipulation. Further, all teachers eventually linked flexibility to learning. The meanings of flexibility for teachers showed that, although they considered the transformation of space to be part of flexibility, their main focus was on being able to polyvalently use the space for a range of activities without changing it physically.

However, the mapping revealed only partial use of the learning spaces. Typically, the teachers with the progressive pedagogical or heutagogical approaches were the most enthusiastic about the relationship between space or flexibility and learning. They employed a range of uses across the whole of the learning space, see Figure 9.

In contrast, teachers who held less strong views about those relationships tended to employ one spatial arrangement and undertake most of their traditional pedagogic activities within that layout. Further, from the constructivist learning literature, it was expected that the differences between a traditional pedagogical and a heutagogical learning environment would be significant. The mapping demonstrated that some differences did occur, as with the increased fluid movement of students, however, there were only limited differences with the spatial transformation of the space.

When the students were asked about the importance of space on their learning, the level of appreciation of the importance increased with the age of the students.

Pedagogic Activities
DE = Delivering; CO = Communicating; CR = Creating; AP = Applying; DM = Decision Making
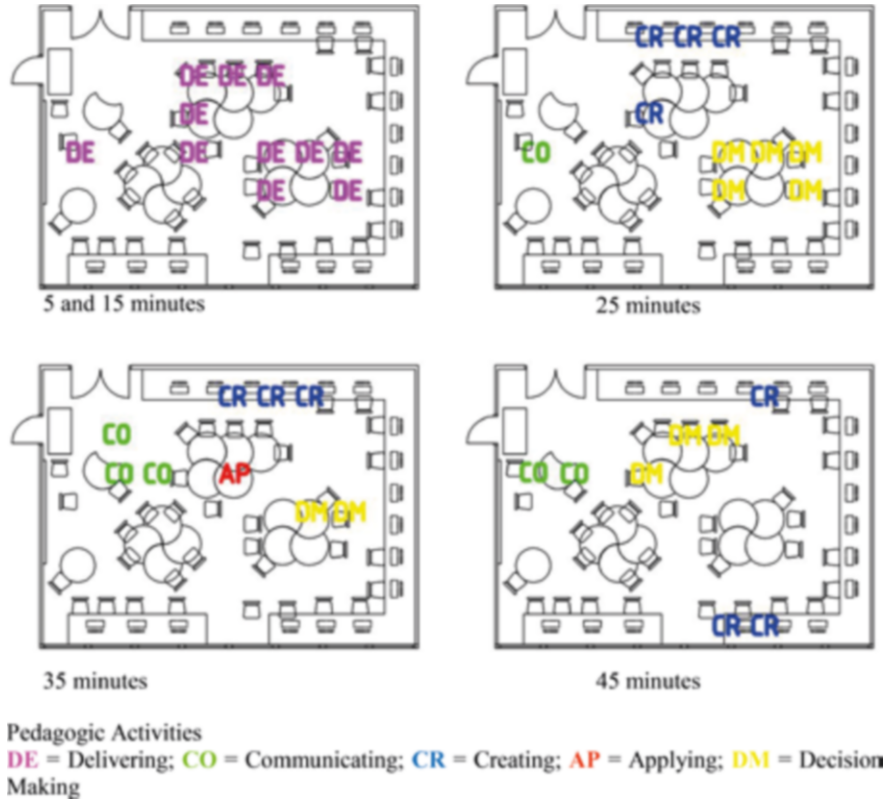
Figure 9. Year 9 community learning changes in use

The Year 7 students did not believe that there was any connection between space and learning but that gradually changed through the years, with the Year 11 students making a strong and positive connection between the two.

Once again, the mapping revealed a practice that contrasted with this belief because little spatial change occurred in any of the age groups. These beliefs on the relationship between space and learning were tested in practice during the participatory action research process where students made significant changes to their learning spaces. These changes engaged the students in their learning spaces and made them aware of the learning opportunities that they created.

As with space, the students' connection between flexibility and learning grew through the age groups. Similar to the teachers', the students' understanding of the meanings of flexibility included some spatial transformation, and some polyvalent use, but the majority defined flexibility in terms of a fluid movement. With this lens, the inverse is highlighted. Thus, where the younger students did not connect learning

July observation

August observation

September observation
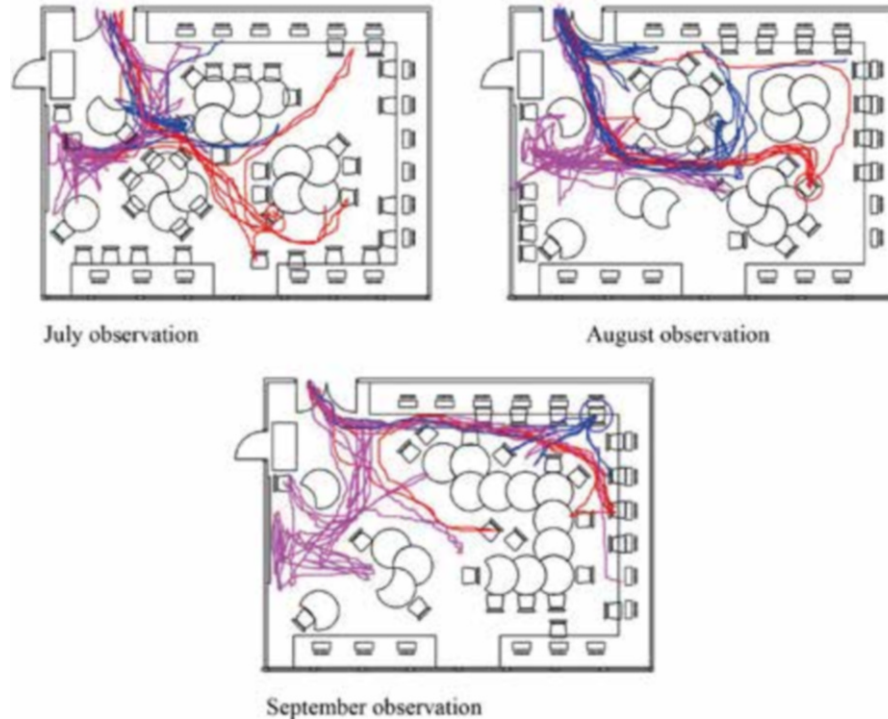
Figure 10. Year 9 community learning movement paths

to fluid movement flexibility, they were the ones who moved more compared to the senior students.

The older students appreciated fluid movement flexibility but, as was shown in the movement mapping, were restricted in their mobility. The Year 9 students made a connection between flexibility and learning, and were fortunate enough to have fluid learning sessions as shown in Figure 10. Further, during the participatory action research process they ensured that their movement was purposeful by providing a range of learning settings as destinations within and outside of the original learning space.

The mapping of uses in the learning spaces showed that the pedagogical activity of "decision-making" occurred infrequently, for example see Figure 4. The Year 9 student-determined learning space was the only location where it occurred to a noticeable extent, refer Figure 9. When this issue was raised with the teachers, they explained that decision-making was a difficult and time-consuming activity to undertake with students.

This hole in the pedagogic activities is interesting especially when decision-making is a significant requirement of modern, everyday working life. Thus,

students are not being given the opportunity to learn and practise decision-making in a learning environment.

The flexible use of learning spaces could be seen as a way of providing decision-making opportunities that require collaborative and cooperative negotiations between students and teachers, and among students. Spatial decision-making opportunities for students could foster feelings of control over their learning spaces that would support motivation, self-esteem, responsibility, and a desire to learn.

Between Control and Freedom

The work on discipline by Foucault (1979) is useful in understanding the issues of control revealed in this research. The interviews revealed that most believed that teachers control space. This control was evident in the Year 10 teacher who maintained a U-shaped furniture arrangement, see Figure 4.

The students had little say over their learning environment, with the space and associated social interactions between the students highly controlled by the teacher. This spatial control was disliked by the students who were fully aware of the power implications of the layout.

The senior students expressed a desire to engage with their learning spaces as much as did the junior students. However, the limitations of curriculum and examinations caused teachers to forego the opportunities for constructivist learning in favour of a teacher-directed approach. As a result, the importance of the learning space for teacher-directed learning was diminished.

The work with the Year 9 PAR group showed that students became thoroughly engaged when provided with the opportunity to manipulate their space. This engagement occurred not only in the development of their learning spaces but also with their learning. For these students manipulating their space provided an impetus to learn. Further, in a social constructivist sense, the social connections established through the act of spatial manipulation were deep and lasting.

This is evidenced by these students maintaining a positive social relationship with the author well beyond the confines of the one term PAR process and frequently providing updates of their learning when we met subsequently. Latour suggested that emancipation "does not mean 'freed from bonds' but well-attached" (2005, p. 217). In this sense the PAR students became "well-attached" to other students, to the researcher, and to their learning place, and thus felt some emancipation from traditional school practices.

Teacher levels of control extended from the spatial to the corporeal as the teachers actively limited the extent to which students were permitted to move as they learned. As discussed earlier, there is a positive relationship between movement and learning found in the literature. The interviews with students revealed that they wanted to be able to move to support their learning.

They understood that movement had some social component, permitting them to access their friends, but that such movement came with a responsibility to learn and

not to disrupt. However, the mapping of the learning spaces at the case study school demonstrated that, with the exception of the Year 9 students, the majority of students were typically static during their learning. This showed that although the space had some influence on student movement, it was not the guiding factor. The students reported that the lack of movement was not due to the space but was due to teacher control.

The control over student movement by teachers could be viewed as comprising surveillance. During the PAR process, the Year 9 students were exploring the transformation of their learning space to support their learning, and on occasions teachers perceived a reduced level of supervision over the students. Two incidents demonstrated a level of covert surveillance, and thus power, over the students. In the first, the PAR students changed the location of the student access phone away from a noisy hallway, but also away from the staffroom.

In the second, the PAR students created several learning settings within the hallway, which limited a teacher's view from her desk. The arrangements for both of these spaces were subsequently returned to their original layout restoring the teacher's ability to engage in surveillance. A negative comment by the Year 9 lead teacher regarding the enclosed nature of a newly created breakout space to the rear of the large room similarly highlights the teacher's need for supervision. These examples demonstrate the tension between the need for students to feel some level of privacy and the teachers' need for supervision.

Dewey (1938–1939) advocated a freedom of mind based on a freedom of the body. This study revealed that the freedom of the body is controlled by some teachers for maintaining order and supervision. This control and lack of freedom for students was fully recognised by teachers and students alike. The freedom that the students could experience was explored in the participatory action research process with the results fully supporting the views of Dewey. However, some teachers were not willing to release their power over the students even if it would enhance learning opportunities.

The restrictive level of teacher control of space and movement encountered in the Year 10 classroom could be seen as a constrictor of learning. When the control of the space was transferred towards the students the learning space and movement became enablers, as was experienced with Year 8 and Year 9 students. The PAR project with the Year 9 students showed that if control of the learning space was transferred towards the students their attitudes towards space changed.

The "spatial silence" experienced by students, as described by Fisher (2002), was removed as the students actively and vocally engaged in their space. Their interest and commitment was evident. As a result, they and their teacher reflected that their approach to learning had markedly improved. Further, their teacher commented on the PAR students' increased feeling of responsibility for both their learning space and their learning.

The responsibility for control and the retention of power did not rest solely with the teachers. There were other actors that impacted on space and flexibility. The timetable had a significant effect as an organiser of the educational, social, spatial, and temporal elements of the school. The timetable was constructed by the school

leadership and was a controlling actor over teachers, students, and spaces alike. It was a rigid catalogue of allocation that traditionally placed one class with one teacher who was responsible for one subject in one room.

At the case study school the timetable was compiled using the subjects as the basis, then teachers were allocated to the subjects, and finally a room was designated. However, the timetable hampered ownership of subject, space, and time by teachers and students alike. It also restricted the manipulation of spaces. As a result, teachers felt distanced from, and frustrated with, their spaces and opportunities to change it. Students felt little connection with learning spaces that they only passed through.

Thus, instead of allocating specific subjects, teachers, and students to spaces a possible solution could be a more collaborative, negotiated approach to timetabling. Multiple teachers and students could be allocated to a range of spaces for an extended period of time and the actual apportionment of spaces, teachers, students, and learning could be undertaken on a negotiated basis at the time of need.

This may more closely satisfy the intent of student-centred learning that benefits from a variety of groups of students with an array of teachers undertaking a range of learning modalities in a multiplicity of learning settings. It would provide several teachers and a large number of students with opportunities to satisfy their teaching and learning needs in a supportive learning place.

Student-centred learning spaces could be seen in similar terms as student-centred learning. Teachers who practise student-centred pedagogy provide an overall learning framework within which students can organise their learning. In the same way, teachers could provide an overall spatial framework within which students can organise their own learning spaces to suit their learning.

The Year 8 teacher alluded to this when he said: "So the teachers may well set [the space] up initially, but if there is that ethos of flexibility, then I think students would say 'oh well, I think it would be better this way' ". Thus, some of the control of the learning spaces could be transferred towards the students. This could be achieved by teachers providing a structure to the space through scaffolded learning spaces. Similar to scaffolded learning, teachers could provide an appropriate spatial framework within which the students could successfully explore their spatial needs.

At the point that the students' learning moved beyond the current spatial supports, the teacher could extend the scaffolding to provide further opportunities for spatial exploration. Thus, the learning space would become a shared responsibility, with the teacher framing the space for the students to manipulate. Through this process, teachers and students could collaborate on their learning spaces in an equitable learning relationship.

CONCLUSION

'Change life!' 'Change society!' These precepts mean nothing without the production of an appropriate space … new social relationships call for a new space, and vice versa. (Lefebvre, 1974, p. 59)

In reference to Lefebvre's quotation above, this work describes how flexibility can affect the new social relationship of learning through a new space, and vice versa. Flexibility provides a multiplicity of opportunities for interactions, discussions, collaborations, conflicts, connections, and reconnections.

For learning, flexibility can be seen as necessity, spontaneity, equity, democracy, and empowerment. It breaks the teaching panopticon to create a learning place of ownership, respect, and responsibility. Through this study, flexibility has been re-placed, not as a product of building, but as a process of learning.

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PART 2

THE SOCIO-CULTURAL IMPLICATIONS OF LEARNING ENVIRONMENTS

NEDA ABBASI

4. ADOLESCENT IDENTITY FORMATION AND THE SCHOOL ENVIRONMENT

INTRODUCTION

Forming an identity that sets a firm foundation for adulthood is the central developmental concern and issue of adolescence. Identity formation is a lifelong development which begins from "the baby's earliest exchange of smiles" (Erikson, 2008, p. 226). Nevertheless, it significantly emerges to individuals' consciousness or awareness during adolescence due to some significant physical and psychological changes as well as the emergence of new social expectations from the individuals (Adamson & Lyxell, 1996).

School is among the important contexts within which adolescent identity formation unfolds. Despite a great deal of theoretical discussions and empirical studies in disciplines of psychology and education, little is known about the ways that school environments might support adolescents in their developmental task of identity formation. Similarly, discussions about identity formation during adolescence seem to be missing when designing a new school or refurbishing an existing one. There is a clear knowledge gap about the impacts of school environments on adolescent identity formation and much of the potential of these environments in supporting this developmental task are left untouched.

This chapter presents an interpretation of identity formation that informs creating school environments responsive to this crucial developmental task during adolescence. A school environment was considered in terms of its social, pedagogical, organisational and other key components. Nevertheless, a particular emphasis was placed on the physical component of school environments.

Such insights are expected to contribute to an understanding and awareness of identity formation for educational planners, architects, educators and all others involved in the planning, design and decision making and hopefully creating school environments that support adolescent identity formation.

IDENTITY FORMATION DURING ADOLESCENCE

Identity is a complex phenomenon. Defining identity and the ways that it develops over the course of human life have inspired many researchers for many years. In the literature, different terms such as 'self', 'ego', 'identity', 'I' and 'me' have been

used interchangeably and there is argument for the distinct nature and definition of each term (Erikson, 1968; Marcia, 1994). It is not within the scope of this chapter to further address these distinctions and depending on the context to mean the same developmental process, the terms 'identity', 'ego identity' and 'self-identity' are used throughout this review.

Erikson was among the first theorists who introduced and elaborated important concepts related to identity in adolescence (Adams & Marshall, 1996; Kroger, 2003). In conceptualising identity, he drew on an early theoretical use of the term 'identity' by Sigmund Freud as well as his own clinical experiences with veterans returning from World War II and emotionally disturbed young people. He defined "a sense of identity" as "a subjective sense of an invigorating sameness and continuity." According to him, a sense of identity is never fully achieved at one stage of an individual life; it is "constantly lost and regained" and a lifelong development. However, identity formation can be considered as the "normative crisis" of adolescence due to the development of "the prerequisites in physiological growth, mental maturation, and social responsibility to experience and pass through the crisis of identity" (Erikson, 1968, pp. 23, 91).

In his conception of identity, Erikson (1968, 1974) considered a significant role for the social context. According to him, identity is shaped by the confluence and interrelation of three elements: (1) an individual's biological characteristics; (2) psychological needs, interests and defences; and (3) the social and cultural context within which a person resides. Social and cultural contexts support the formation of individuals' identities by recognising their biological characteristics and psychological needs and providing opportunities for their expression.

James Marcia is another person who is credited for his significant contributions to broadening empirical investigations on identity formation (Adams, 1992). Observing the insufficiency of the dichotomy of "identity versus identity confusion" in Erikson's conception to capture the variety of styles of identity resolution for different individuals, Marcia (1994) proposed a practical conceptualization of ego identity development, the ego identity status model. The model is composed of four identity statuses of 'identity achievement', 'moratorium', 'foreclosure' and 'identity diffusion', which are determined based on the twin criteria of 'exploration' and 'commitment'.

Exploration refers to "the extent to which an individual has genuinely looked at and experimented with alternative direction and beliefs" and commitment refers to "the choice of one among several alternative paths in the different interview domains" (Marcia, 1994, p. 73). Identity achievement, the positive end of the ego identity status model, is in place when an adolescent experienced a period of exploration and made rather firm commitments (Marcia, 1994).

Drawing upon Erikson's conceptualisation of identity formation and Marcia's ego identity status model, empirical studies have emerged which identify a number of common factors and experiences involved in adolescent identity formation. Studies conducted by Peter Bloss (1962, 1967, 1979), among others, have made significant

84

contributions to broadening our understanding of the first crucial experience to be considered here: separation and individuation.

Relational context is the second important factor in identity formation during adolescence. Erikson's emphasis on the role of social context and the necessity of individuals being recognised by the community in the process of identity formation highlights the important role of relational context. In addition, studies on women's identities have also born out the importance of relational context (e.g., Gilligan et al., 1990). Adolescents' identities are not the mere products of separation or individuation, marked by autonomy and independence, or 'intrapersonal dialogue' (Flum & Levi-Yudelevitch, 2008).

Instead, identity formation involves the complex interplay of intrapsychic processes and interpersonal experiences (e.g., Marcia, 1993; Guisinger & Blatt, 1994; Blatt & Blass, 1996). An issue to be noted in relation to the relational context of identity is the significance of providing response and support for adolescents. This is what Josselson (1994, p. 90) describes as the relational dimension of "holding" and suggests that only adolescents who have been supported properly are confident enough "to venture forth into new experience, to risk separation and individuation."

A supportive school environment along with teams, teachers and other trusted adults who provide adolescents with support for exploration of identity alternatives and confirm adolescents' commitments are some embodiments of holding environments (Josselson, 1994; Good & Adams, 2008). Research on adolescent identity formation in the family context (e.g., Cooper et al., 1983; Grotevant & Cooper, 1985; Grotevant & Cooper, 1986; Allen et al., 1994; Berzonsky, 2004; Matheis & Adams, 2004) provide further evidence for the importance of "holding environment." A consistent finding of these studies is that adolescents in families that encourage individuation and a degree of exploration within a warm and supportive relational environment tend to be in identity achievement status (Cooper et al., 1983).

The third crucial experience involved in identity formation during adolescence is psychosocial moratorium. Psychosocial moratorium is a period "during which the individual through free role experimentation may find a niche in some section of his society" (Erikson, 2008, pp. 224–225). During adolescence, individuals are faced with the urgency of making choices and decisions that lead them to a more final self-definition, irreversible role patterns and life-long commitments. It is during this period that societies offer individuals intermediary periods between childhood and adulthood. Defining psychosocial moratorium as "a delay of adult commitments by youth as well as a period of permissiveness by a society to allow young people the exploration time", Kroger (2007, p. 12) regards it as a necessary period if adolescents are to form "deeper and more meaningful psychosocial commitments."

Marcia (1994) goes as far to suggest providing adolescents with an 'exploratory period' as a starting point for intervention with regard to adolescent identity formation. In the context of educational institutions, this exploratory period may involve placing less pressure on students to make firm decisions, offering the possibility of

switching major areas of studies, developing flexible curricular requirements and providing counselling services (Marcia, 1994).

This section aimed to examine identity formation during adolescence by highlighting theories of two leading figures in the field: Erik Erikson and James Marcia. In addition, references were made to the empirical studies of identity formation in order to address some of the influential experiences and factors determining how identities are evolved and developed during adolescence. The next section places the discussion in the context of schools and focuses on the issues and factors associated with education of adolescents for identity formation processes.

ADOLESCENT IDENTITY FORMATION IN THE SCHOOL CONTEXT

School is an important context within which adolescent identity formation is shaped and influenced. The significant amount of time that adolescents spend in school is a basic reason for the importance of schools in identity formation. In addition, adolescents are engaged in activities and programs in schools that can help them discover their abilities and interests and further develop them.

A considerable part of adolescents' social interactions and interpersonal relationships, in particular with peers, are also formed in schools. In that sense, schools can become arenas for exploration and socialisation where young people experiment with different roles, values and relationships. This is particularly the case for many adolescents living in poor and working class urban communities and deprived of enough opportunities for exploration outside schools (Nakkula, 2003). In schools, adolescents are confronted with the necessity of making decisions or selecting pathways for such issues as career directions, gender orientations, life values and attitudes for the future.

Choices and decisions made in schools are affirmative of adolescents' identities and can facilitate the emergence of commitments which is the first sign of identity achievement (Lannegrand-Willems & Bosma, 2006). Referring to some of these reasons, Kroger (2007) argues that factors such as general school structure and climate, alongside interactions with teachers and peers all provide social and emotional experiences with possible long-term implications for identity.

Only a few empirical studies have investigated the ways that school context might influence identity formation processes during adolescence. In one study Lannegrand-Willems and Bosma (2006) examined the impact of school climate on identity formation in three high schools which were different in terms of students' socioeconomic backgrounds. Their findings suggested that impacts of context in the three schools became stronger as the school year progressed and the level of students' identity exploration and commitment was higher in the school with students from higher socioeconomic backgrounds. The study does not provide a clear image of factors and variables in the schools that support adolescent identity formation.

Nevertheless, by identifying a confluence of students' socioeconomic background and the impacts of schools on identity formation, the study highlights the complicated process through which schools might support or deter adolescent identity formation. In another study, Roker and Banks (1993) examined the effect of school structure on identity formation of adolescent girls who were attending both private and state schools. Their findings showed a significantly greater number of girls attending private schools in foreclosure status compared to those attending state schools who tended to be in moratorium and identity achievement statuses.

The authors argued that the homogenous environment of the private school that exposed students to few ideological viewpoints along with the pressure on students to make decisions about career plans might account for a higher number of foreclosed adolescents. On the contrary, adolescent girls in the state school were exposed to a greater range of different ideological viewpoints and belief systems, a context that facilitates exploration of alternatives and making commitments (Roker & Banks, 1993). This study provides evidence for the role of school environments in facilitating or preventing adolescents' exploration of different alternatives.

Two other studies of identity formation in the context of college and universities are relevant to this review. Adams and Fitch (1983) studied possible psychological environment effects on identity status and ego stage development of university students. They found that educational institutions promoting a supportive intellectual environment while offering critical and analytic awareness of societal issues facilitate identity development through creating conditions for "exploring and broadening one's perspective."

In a similar study, Adams et al. (2000) examined the impacts of family and educational environments on university students' identity formation and ego strength. Their findings suggested that supportive educational environments and democratic families positively correlate with ego strength and facilitate identity formation during the college or university experience. In other words, support systems embodied in democratic family environments and supportive educational environments help "adolescents feel comfortable to more fully explore their identity options" without being "pressured to adhere to certain values by the school or from their parents" (Adams & Palijan, 2004, p. 240).

A review of the existing studies of adolescent identity formation provides insights into the complex interrelationships of factors and contexts influencing this developmental process in educational environments. For example, a school environment may prove less effective if the policies, educational philosophies and teaching practices merely provide alternatives or choices for adolescents' identity exploration and fail to pay attention to the role of relational contexts. It is equally important that the relational contexts within and outside a school provide necessary support, guidance and affirmation for adolescents to explore and make free choices and commitments. It is essential to take into account the complex interrelationships of factors when examining the implications of adolescent identity formation for schooling.

SCHOOLING FOR ADOLESCENT IDENTITY FORMATION

In the discipline of education, there have been efforts to better understand attributes of different learning environments and activities in middle- and high- schools which are based on adolescents' developmental needs and characteristics (Phelan et al., 1998). Only a few studies examined the implications of identity formation for schooling. Even in this sparse body of research on schooling for identity formation, more concrete outcomes, contents and constructs associated with identity formation processes such as self-esteem, self-concept, social and emotional well-being were the study focus. This section summarises some of the implications of identity formation for education of adolescents which have been identified within existing educational research.

Building upon Erikson's (1968) emphasis on the experience of "psychosocial moratorium" as a determinant of an optimal identity development by the passage through adolescence, some educational researchers have considered 'creating opportunities for exploring diverse values, roles and relationships' as one main concern of schooling for adolescent identity formation. Nakkula (2003, p. 12) regards multiple possibilities for exploration as a way to help adolescents "redirect their investment of mental or psychic energy" and by doing so increase their options for healthy development. Similarly, Dreyer (1994) argues that educational environments that stimulate exploration and commitment encourage adolescent identity formation.

Outlining some characteristics of an "identity-enhancing curriculum," he suggests that providing opportunities for exploration of alternatives in such areas of life as occupation, religion and politics is one way that curriculum can promote identity achievement (Dreyer, 1994). In creating possibilities for exploration in schools, special attention needs to be paid to providing real-world work experiences for adolescents. According to Cooper (1998), a characteristic of schools which foster identity formation experiences is that they provide adolescent students with real-world work experiences, internships and mentoring programs for career decisions.

Vocational directions and career choices form an important domain of adolescent identity formation and inability to make commitments in the realm of occupational identity is what disturbs most adolescents (Erikson, 1968).

Educational research also suggests 'relationship building' as another important factor with a significant role in promoting adolescent identity formation in schools. Nakkula (2003) views fostering connectedness to school and engaging adolescent students as the key to identity development in school. This requires teachers and other supportive adults in schools who develop caring and compassionate relationships with their adolescent students and in turn foster students' relationship to learning (Nakkula, 2003).

Similarly, Dreyer (1994) points out the importance of teachers' building supportive relationship with their students. Multiplicity of social roles in adolescence brings both opportunities for growth and developing identity as well as confusion and loss of identity. Hence, maintaining consistency across roles is the main challenge

for adolescents. One way by which school can contribute to the role continuity in adolescents is through caring and compassionate responses from teachers who take the time to know each student as "a whole person with a complex life and dreams that extend far beyond the classroom" (Dreyer, 1994, p. 132). Other researchers also referred to development of meaningful and trusting relationships with adolescent students as a dimension of teachers' responsibility with regard to supporting students' connection to the identities of their families, communities and peers (e.g., Stanton-Salazar, 1997; Phelan et al., 1998).

An important arena within which relationship building can be developed and encouraged is school-based extracurricular programs. These programs help adolescents to connect to the world in different ways and experience meaningful relationships with peers and adults. Drawing on an extensive literature review, Feldman and Matjasko (2005, p. 161) state that participation in extracurricular activities is "a means to express and explore one's identity, generate social and human capital, and offer a challenging setting outside of academics."

Cotterell (2007) views relationship building and creating relational connectedness as essential elements of a school's support system that contributes to adolescent identity formation. Creating a connection support structure starts with addressing the question of how the school presents itself to the outsider, which has to do with the impression that the school offers to newcomer students and begins with questions of "what is the school like? is it a friendly place? do the teachers care about their students? will I be happy here?" (Cotterell, 2007, p. 200). In addition, support should be integrated within the school culture rather than merely enacting through specific programs and activities. According to Cotterell (2007), this type of support in schools is reflected in the concept of a "supportive school environment" which is best captured in Mcmillan and Chavis (1986)'s statement on a "sense of community":

> Strong communities are those that offer their members positive ways to interact, important events to share and ways to resolve them positively, opportunities to honour members, opportunities to invest in the community, and opportunities to experience a spiritual bond among members. (McMillan & Chavis, 1986, p. 14)

De-instituionalising schools, humanizing curriculum, maintaining connections between the school and its constituency and ensuring accessibility of staff for students are among the factors that help in creating a supportive school environment, Cotterell (2007) maintains. Of paramount significance in this discussion about developing a connection support structure in schools is his reference to some of the implications of these factors for the physical environments of schools.

He elaborates de-institutionalizing schools as "establishing an environment that emphasizes the human aspects of organization" which has to do with managing time and space by the school in a way that students' experiences can be enriched (Cotterell, 2007, pp. 221–222). Provision of ample sized and appropriately located spaces for students to socialize and hang out in break time is a step towards the space management that can enrich students' experiences. Along with planning

social events, provision of appropriate physical settings is also suggested as a way to increase the opportunity for informal interactions among students and teachers. Finally, the proximity of teacher common rooms to the student learning spaces is referred as a factor to ensure accessibility of teachers and school staff for students (Cotterell, 2007).

In addition to 'creating opportunities for exploring diverse values, roles and relationships' and 'relationship building' which play important role in identity formation in schools, two teaching approaches were suggested to have impacts on this developmental task of adolescence: community service learning and cooperative learning. Involvement in community service learning activities in schools fosters more relevant and meaningful learning, increases adolescents' social awareness and by allowing them to explore identity alternatives supports their identity development (e.g., Youniss & Yates, 1997; Woolfolk Hoy et al., 2001; Adams & Palijan, 2004).

Drawing on the findings of their studies on adolescents participating in a year-long service learning program, Yates and Youniss (1998, 1999) argue that community service learning, through closing the gap between schools and the communities outside, provides positive identity-defining experiences for adolescents. The significance of cooperative learning for identity formation appears to be linked to its impacts on the relational dimension of identity formation. Slavin (1995) points out that cooperative learning supports interracial friendships, prejudice reduction, acceptance of disabled students, self-esteem, peer support for academic goals, altruism, empathy, social perspective-taking, liking fellow classmates and feeling liked.

Educational research concerning the ways that learning environments and curricula can be structured to support identity development provides insights into the implications of adolescent identity formation for schooling. Two common factors identified include: (1) providing opportunities for exploration of identity alternatives; and (2) encouraging relationship building and a supportive school culture. An important point that should be noted is the interrelationship among these factors. It is in the context of relational connectedness and belonging to a social group that adolescents are offered a secure base for exploration of identity alternatives and making meaningful commitments (Cotterell, 1996).

CHARACTERISTICS OF SCHOOLS THAT SUPPORT ADOLESCENT IDENTITY FORMATION

Reviewing existing research and empirical studies (See Table 1 for a summary of this), two characteristics of school environments that support adolescent identity formation can be proposed which are further elaborated in this section:

i) They are supportive addressing adolescents' individuation and social integration needs; and

ii) They offer adolescents opportunities for developmental exploration.

90

Table 1. A summary of literature review on adolescents' identity formation and educational research examining the implications of this developmental process for schooling – Author

	Common themes and findings	
	Key factors	*Related issues*
Adolescents' identity formation process	Separation or Individuation	
	Relational connectedness	Support
	Psychosocial moratorium	
Implication of adolescents' identity formation process for schooling	Possibilities for exploration of identity alternatives	Choices in curriculum
		Real-world work experiences
		Extracurricular programs
	Relational connectedness	Cooperative learning
		Community service learning
	A supportive school culture	

A Supportive School Environment Addressing Adolescents' Individuation and Social Integration Needs

In a supportive school environment that individuation needs are addressed, every adolescent student feels known and valued as an autonomous and independent member of the school community. A supportive school environment also provides for adolescents' social integration needs. At a basic level, this has to do with encouraging social interactions and encounters.

At a more profound level, social integration needs can be addressed through developing a supportive community where all students, teachers and other school staff are included and connected. An important attribute of such a supportive community has to do with adolescent students' perception of availability and accessibility of teachers and other school staff support. In addition, cooperative learning which has considerable social benefits is also practiced in such a school environment.

Another attribute of a school with a supportive environment addressing individuation and social integration needs is 'smallness'. Considering identity formation as "a product of the individual interface with the society," Josselson (1994, p. 22) defines two forms of interventions for identity formation: individual-level intervention and social intervention. She considers the attempt to reform social institutions as one form of social intervention and suggests reducing classroom size and faculty teaching loads as one aspect of this reform in the context of schools. This intervention in the institutional level creates "conditions where students can get

to know new (and perhaps admired) others in unpressured circumstances and learn about possibilities for being and doing in a way that can make some personal sense to them" (Josselson, 1994, p. 24). Findings of studies on 'school and classroom size' provide support for the proposition that smallness of school and classroom support adolescent students' needs for individuation and social integration (Barker & Gump, 1964; Cotton, 1996).

Literature on school size suggests increases in student performance, a more positive school climate, a more personalised learning environment, more collegial cooperation for teachers, greater parent involvement and satisfaction and cost efficiency as among the advantages of 'smallness' (Association for Middle Level Education (AMLE), 2004). A common finding of the studies that examine the relationship between school size and self-concept (e.g., Grabe, 1981; Foster & Martinez, 1985; Rutter, 1988; Stockard & Mayberry, 1992) is that small schools have positive impacts on both personal and academic self-regard. Similarly, the findings of the studies that explore the impact of size on the interpersonal climate in schools (e.g., Burke, 1987; Smith & Gregory, 1987; Fowler & Walberg, 1991; Kershaw & Blank, 1993), mainly focused in terms of "elements such as relations among students and between students and teachers, especially teacher attention and demonstrations of caring toward students," show positive correlations between small schools and favourable interpersonal relations (Cotton, 1996).

Nevertheless, research demonstrates that smallness "does not automatically guarantee school success" and by itself does not account for positive social consequences and academic-related benefits. Small schools have the potential for providing meaningful and personalised relationships between students and adults. It is the 'personalised school environment' that contributes to these positive effects and "personalization is the key for the creation of healthy and positive small communities of learning" (Conchas & Rodriguez, 2008, pp. 117–118).

Opportunities for Developmental Exploration

The essence of offering opportunities for developmental exploration has to do with supporting adolescents to experiment with various social roles and values, try out diverse activities and programs and explore different interpersonal relationships. At a primary level, creating opportunities for developmental exploration to support adolescent identity formation should be addressed within a school curriculum as well as school-based structured extracurricular and leisure activities. The school curriculum should provide adolescent students with choices which may take various forms.

Choices may be in terms of subject areas that students take on, approaches to learning and the ways that students demonstrate their understanding and learning. Given the importance of making commitments in the realm of occupation (Erikson, 1968), providing adolescents with exploratory opportunities with regard to occupation and future career needs to be emphasized. One way to do so is for schools to offer adolescents real-world work experiences through promoting

92

the links with industry and businesses. At a broader level, connection to the world outside school can be regarded as a key factor that expands the scope of opportunities for adolescents' developmental exploration. In that sense, schools' learning environments should not be confined by its physical boundaries. Instead, school environments should be connected to the world and broader societies. Connections to the world beyond the confines of a school may take the forms of physical links and partnerships.

These connections may also become possible by mean of using Information and Communication Technologies (ICTs). ICTs have the potentialities to open up new learning opportunities. In addition to being creative tools to actively engage students in learning activities, providing access to enormous amount of information, facilitating personalised learning and distant assessment, ICTs allow students to have 'virtual' practical experience where practical activities may be expensive or even dangerous.

ADOLESCENT IDENTITY FORMATION IN THE CONTEXT OF AUSTRALIAN SCHOOLING

Four case studies are briefly presented here in order to provide insights into the implications of adolescent identity formation for the design of physical spaces of schools in the context of Australian secondary education. These case studies are schools within which some of the educational strategies and design-related implications identified from the literature review are manifested. A summary of educational philosophies, design principles and responses in these four case study schools which can be considered as contributing to adolescent identity formation is presented in Table 2.

Australian Science and Math School (ASMS)

In the ASMS, the concept of smallness was implemented through open plan and offering students the freedom to move around and having a degree of control over spaces. Except for a number of specialised spaces, service spaces and administrative areas, the general learning spaces are loosely defined open spaces shared by tutor groups. The groups meet for forty minutes at the start of the day in their assigned areas but do not necessarily spend much other time there. Students' lockers are designed on wheels to be moved around and placed where their tutor groups frequent. Open plan also facilitates accessibility of teachers and fosters students' perception of availability of support, if they need it. See Figures 1 and 2.

Canning Vale College (CVC)

In CVC, "learning neighbourhoods" were designed to support the concept of smallness and create a chance for student groups to occupy certain space and have

Figure 1. A learning common with loosely
defined home bases for tutor groups

Figure 2. A teachers' preparation area
which is open to a learning common

ownership over these spaces. A learning neighbourhood is an open space shared by four student cohorts that take over a certain corner of the space and also collaborate with each other. The two learning neighbourhoods are in two levels of a relatively self-contained building called a "learning community" and share a number of spaces such as teachers' offices and general purpose studios. A sense of community and social integration were further addressed through creating social gathering spaces for the whole school (refer Figures 3 and 4).

Figure 3. A social gathering space created by
widening the staircase and spacing out steps

Figure 4. A learning neighbourhood

Mindarie Senior College (MSC)

In MSC, the atrium space is the central hub and social heart of the school. Among the features of this space are being spacious, enjoying good natural light and views to external courtyard and having adequate seating areas are. In addition to the central location of the space, which makes every school member having to pass it a number

of times each day, a lot of social activities and events happen in this space which facilitate building relationships and promote a sense of community. Another social space of the school, the café, is adjacent to the resource centre and enjoys a strong inside-outside connection. Refer Figures 5 and 6.

Figure 5. The atrium space as the social heart and central hub of the school

Figure 6. The school café with a strong connection to outdoor spaces supporting students' privacy needs

Reece Community High School (RCHS)

In RCHS, outdoor spaces and covered walkways act as a form of social spaces contributing to students' privacy and personalisation needs. Among features of these outdoor spaces which may account for their popularity among students, as evidenced by a walk-through observation during the break time, are having the feeling of being among a group of students, being involved in some types of activities and keeping an eye on what other students are doing. These covered walkways are structured in a simple and easily readable way, which allows for spontaneous interactions among adolescent students to happen. Refer Figure 7.

Figure 7. The covered walkways connecting building blocks as a form of
social spaces – Left: Modified by the author on a plan obtained
from the school information brochure

IMPLICATIONS OF ADOLESCENT IDENTITY FORMATION
FOR SCHOOL DESIGN

Integrating the findings form the literature review and the exploration of four case study schools, five design principles are proposed which can contribute to adolescent identity formation through supporting the two characteristics of 'schools as supportive environments addressing individuation and social integration' and 'schools as contexts offering opportunities for developmental exploration'.

Downsizing Schools / Design to Support the Idea of Smallness

There is no general agreement about how many students and teachers would make a small group. However, this does not affect the design principle of downsizing schools. The point here is considering the ways through which design supports the idea of smallness of school size. The research and practice of school design suggest a number of design-related strategies that contribute to downsizing schools including "clusters of classrooms" (Moore & Lackney, 1995) and "schools-within-a-school" (Brubaker et al., 1998; Davies, 2005).

A common theme emerged from case studies was "fostering ownership and belongingness to a particular space" as a guiding design principle to contribute to the idea of smallness. Two design responses to this principle include designing: (1) a cluster of classroom spaces that can be opened up to each other; and (2) an open space within which a number of class group spaces are loosely defined.

Designing Social Spaces

Social spaces were found to play a significant role in some of the processes involved in adolescent identity formation. The importance of social spaces in schools is linked to the relational dimension of identity development and encouraging

Table 2. Educational philosophy, design principles and responses in four case study schools contributing to adolescent identity formation (as specified in school year of 2008)

	Educational philosophy	Design principles	Design responses
ASMS	Providing personalised learning Maximising learning choices Encouraging social and collaborative learning Connecting students to the world outside	Spaces for theory, practice and social learning Student-centred spaces Integration of ICTs into spaces	"Learning commons" and "learning studios" Openness and transparency between spaces Maximising accessibility of teachers' preparation areas through openness
CVC	Developing the environment, structure and curriculum which support students' exploration Creating a variety of opportunities for formal and informal learning inside and outside the school Fostering within students a sense of ownership and belonging to the school community	Flexible spaces to allow users a degree of customization Breaking down scale and organization of the facility to foster a sense of belonging	Moveable walls to maximise flexibility of spaces Large classroom spaces to enable uses for a range of teaching and learning styles Learning neighbourhoods Social and gathering spaces in circulation areas Indoor nooks with soft seating
MSC	Supporting students to move towards increased independence Encouraging students to establish supportive relationships Developing connections to the local community Promoting cross fertilization of ideas across the curriculum	Welcoming learning environments Flexible design to promote flexible learning styles and teaching approaches Centralized building to house different specialist faculties instead of separate building blocks	A variety of social spaces inside and outside the buildings Creative use of circulation spaces for individual and small group learning Learning spaces which can be separated or opened up to be used flexibly
RCHS	Providing personalised learning Encouraging independent learning skills Developing connections to the local community Fostering within students a sense of belonging to the school community Building powerful relationships among students and teachers	Design incorporating diversity & flexibility Attractive, safe and secure spaces for formal and informal learning Seamless provision of ICTs	Multiple teaching and learning spaces of various sizes Use of operable walls to maximise flexibility of spaces Principal learning areas in middle school as students' home bases Personal workstations in the senior school

exploration in the realm of relationships. Social spaces might be created in different scales ranging from a small corner of a common space shared by some classrooms to a large atrium space in the heart of a school building. They may also take different forms accommodating informal and formal gatherings of individuals.

Creating social spaces in schools do not necessarily require complex design. For example, a social space may simply be defined in a corner of an open learning space by placing comfortable couches. An important consideration with regard to the design of social spaces in a school has to do with the development of a clear understanding and knowledge of the school context, students' specific needs, social and cultural backgrounds as well as attributes and needs of the local community.

Maximising Flexibility

Educational trends, the needs of schools and communities, the demands of societies and above all interests and abilities of student cohorts change over time. Spaces need to keep pace with these changes if it is to support the changing and emerging choices and pathways offered by schools. Flexibility or design of flexible spaces is suggested as a response to this challenge. Two main approaches to flexibility include achieving flexibility through: (1) a variety of spaces; and (2) a "changing" space or a space capable of being turned into different spaces. Two design-related strategies relevant to either of these two approaches to flexibility are "maximising openness of spaces" and "reducing the number of fixed architectural elements and furniture."

Addressing Considerations for Design and Arrangement of Furniture

The significance of school furniture for adolescent identity formation was found to be particularly relevant to the characteristic of 'a supportive school environment'. Furniture is an important factor that has impacts on meeting students' privacy and personalisation needs, social interactions and cooperative learning in schools. With regard to the characteristic of "offering opportunities for developmental exploration," school furniture can contribute to the integration of technologies into spaces and hence facilitating virtual connection of schools to the world outside. The findings suggest three main qualities for school furniture to support adolescent identity formation including: (1) moveability; (2) appropriate size i.e. being modular; and (3) simplicity of form.

Promoting Transparency

Transparency facilitates giving adolescent students opportunities to enact their independence and autonomy. The issue of duty of care and supervision may account for compromising adolescent students' privacy needs of spending time alone or with their groups of peers in schools. Transparency between spaces allows for passive

surveillance to occur and hence students can be given opportunities to be on their own while the school staff and teachers are keeping an eye on them all the time. Transparency between spaces also supports adolescent students' needs for social integration through maintaining visual relations, a design-related strategy which can contribute to the quality of schools as social environments (Hertzberger, 2008).

CONCLUDING REMARKS

Identity formation is an influential issue significantly influencing adolescents' lives and schools play a major role in shaping and reshaping adolescent students' identities. A great deal of research in disciplines of psychology on identity formation confirms that this as an important issue for adolescents and has uncovered significant aspects of this developmental process and factors involved and their interrelationships. In addition, there have been efforts within the realm of education to examine its implications for schooling. Nevertheless, little is known about the contributions of school environments to adolescent identity formation.

The review outlined in this chapter was mainly carried out to begin to fill this knowledge gap and identify some potential areas for further and future inquiries. The review of theories of adolescent identity formation and educational research exploring its implications for schooling provided important insights into the characteristics of school environments which contribute to this developmental task of adolescence.

This review identified that school environments responsive to adolescent identity formation have two key characteristics: *they are supportive addressing adolescents' individuation and social integration needs*; and *they offer adolescents opportunities for developmental exploration*. Some of the key terms which can describe these characteristics are empowering, social, supportive, cooperative, small and personalised, accommodating of choices, connected and technology-rich, which relate to broad issues and concepts (See Table 3 for a summary of characteristics of school environments responsive to adolescent identity formation).

Future inquiries need to closely examine the two key characteristics and their descriptive terms to cast light into ways of translating them into the language of physical environment design and their impacts on adolescent identity formation. Considering the five overarching design principles identified in the course of this study is the very first step in an attempt to support adolescent identity formation in schools through the design of physical spaces. Depending on schools, the contexts in which they are situated, their people and the processes involved, there might be numerous ways to respond to these design principles.

One may start from examining the ways that the physical environments of schools might support adolescent students' independence and autonomy. Another potential area for research is in relation to the impacts and contributions of physical environments to encouraging social interactions and fostering a sense of community in schools. The role of technologies and how they could be integrated into physical

Table 3. A summary of some of the key words that describe the two characteristics of school environments responsive to adolescent identity formation – Author

School environments responsive to adolescent identity formation are ...

EMPOWERING	Every adolescent student feels known and valued as an autonomous and independent individual.
SOCIAL	Social interactions and encounters are encouraged. A sense of community among school members is fostered. This means that students, teachers and other staff feel that they are part of the school as a community.
SUPPORTIVE	Students perceive accessibility of teachers and other school staff support.
COOPERATIVE	Cooperation among students and teachers is encouraged.
SMALL & PERSONALISED	The school benefits from advantages of 'smallness' of the size of school or classroom.
ACCOMMODATING OF CHOICES	Provision of choices in a school curriculum and the school-based structured extracurricular activities are supported.
CONNECTED	Schools' connections to their local communities, other schools and universities, industries and business as well as museums and libraries are promoted.
TECHNOLOGY-RICH	Integration of Information and Communication Technologies (ICTs) into school environments is encouraged.

environments to facilitate schools' connections to the world outside and broaden explorational opportunities needs to be investigated.

Another influential area of future research has also to do with the ways that physical environments can meet the demands of schools' curricula and accommodate choices provided in them. In the planning and design of physical environments of schools, there is significant potential to contribute to the development of a supportive learning community. For example, future research in this regard may examine the ways that teachers' preparation areas and offices can be designed and located within a school to foster students' perception of support.

It is of paramount importance for school principals and leadership teams, educational planners, architects and all those others involved in the planning and development of new school environments or renovating and upgrading existing ones to acknowledge the crucial role of schools in supporting adolescent identity formation and address this issue alongside pedagogical, organisational, technical, financial and other key issues. Addressing adolescent identity formation in any school development can only be fully achieved when a firm and robust research base exists to guide intervention strategies and improvement efforts.

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5. THE CULTURAL ARCHITECTURE
OF SCHOOLS

*A Study of the Relationship between School Design, the Learning
Environment and Learning Communities in New Schools*

INTRODUCTION

The literature in the area of educational facilities design and the built environment for schools is both vast and fragmented. Broadly speaking, the literature can be grouped into three types, with the first type using the notion of the classroom as a "Third Teacher" constituting physical space as an active agent in the learning process. This type argues the building is a silent teaching partner and the purpose of good design is to remove hindrances to its voice and influence. The second type focuses on educational facilities planning and approaches design in a more pragmatic manner.

The emphasis is upon isolating specific design elements that are common to all school structures (for example, lighting and passageways), quantifying the impact of these elements upon some aspect of schooling (for example, student levels of achievement), with the aim of making design responses to standard elements more predictable and streamlined.

The third type of literature discusses the educational contexts and agendas that have been observed as having, or are predicted to have, a significant impact on what can be achieved in the overall building project, as well as being the reason for the project in the first place. Educational leadership and administration literature also reflects an increasing interest in understanding and cultivating rich learning environments.

It is evident that the literature in the field of school design is commonly underpinned by a profound belief that design matters (Woolner, 2010) and the influence of design is subtle (Taylor, 2000, 2009). It is also commonly noted that establishing a causal relationship between the physical environment and learning is complex. Literature in the field speculates on possible causal links between building design, pedagogy and student outcomes (Behrenbuch & Bolger, 2006; Design Council, 2004).

There is also a growing body of research in the field of school design that indicates there is a link between educational facilities, student learning and teachers' levels of satisfaction. In the past ten years research studies have been growing in number and give research-based support to the conclusion that physical

environments have an impact. Some research suggests an explanation of the exact causes of the impact of school design is complex and will vary according to context (PricewaterhouseCoopers, 2010).

When reviewing the literature, I did note discussions of the impact of specific designs occurred when one or more of the following circumstances or influences existed. When there is significant financial investment in school stock, especially by centralised authorities such as federal governments; when there is a major innovation or era shift, such as Web2 information technologies; and when there are substantial shifts in educational thinking and pedagogical approaches, such as collaborative learning.

In the light of these circumstances, current facilities can be perceived as inadequate for supporting change and transformational agendas. The turn of the 21st Century is one such time with the concurrent influences of the end of the Industrial Age model for the economy (Hargreaves, 2009), the emergence of new information technologies and substantial school stock investment programmes occurring in the United Kingdom, Australia, New Zealand and parts of the United States.

THE THEORETICAL CONSTRUCTS OF PATTERN LANGUAGES AND LEARNING COMMUNITIES

The constructs of pattern languages and learning communities provided me with part of the conceptual framework for investigating the relationship between the learning environment and the learning culture of the schools. These constructs had a number of characteristics in common, these being: engagement; participatory action; individualised support; collaboration; facilitation of others' learning; focus on community behaviours and an improvement focus.

The literature suggested learning communities share many aspects with learning organisations and communities of practice. However, a point of distinction is the added dimension of being a community that is an open, dynamic system in which individuals collectively learn and learning can be an agent of change and improvement. Learning from this perspective is seen as a collaborative activity and knowledge is jointly constructed through a framework of communal values and practices. It is also suggested that a learning community's pedagogy would involve co-operative learning that relies upon person-to-person interaction (physical or virtual), and group processing.

When I reviewed the literature on learning communities, forty-five key characteristics emerged. I grouped these characteristics into five key categories: scale; relationships; configuration; flexibility and enquiry-based learning (see Table 1). These key aspects formed my criteria for identifying a learning community culture.

My framework also incorporated the concept of pattern languages. In the past ten years, a few pattern languages for the design of school facilities in the 21st Century have been devised and used in school design processes by a number of architects,

Table 1. Key characteristics of learning communities in schools

Key aspect	Key indicators
Scale	Human-scale learning environments (physical & virtual) Small communities (less than 150)
Relationships (human)	Participatory Collaborative Learning focused
Configuration	Open systems Adaptive Focus on creating communities not organisations
Flexibility	Environments Pedagogy Modes of learning
Enquiry-based learning	Knowledge construction Learners as teachers/teachers as learners

for example, Nair and Fielding. However, I did not find any one language sufficient for describing the breadth of the features and conditions present in contemporary learning community cultures.

By considering three separate school design patterns, I was able to identify points of agreement between the various patterns. These points of agreement formed the eight key patterns I used in my investigation of the relationship between school architecture and learning (see Table 2). These patterns and principles correlated with key characteristics of learning communities. Therefore, I anticipated architecture designed for learning community cultures would follow these patterns. I also developed a criterion of "features" that would indicate the presence of a pattern or principle, shown in the third column of Table 2.

Whilst the concept of pattern languages established a framework for analysing school design from an architectural perspective and the process of building physical environments, it became evident during the pilot study that school leadership, teachers and students did not specifically use a pattern language when talking about their school environment.

They tended to define space by their personal experience of specific classrooms or examples and the types of work that was possible or not possible in those environments. The stakeholders thought about space in terms of the opportunities it afforded. In the case study schools, leadership did not rely upon a specific design language to determine or define the goals of the school.

The principals were confident the school's learning culture and context was driving the design of the built environment rather than the other way around. The

Table 2. Criteria for analyzing design of school environment [Table based on Bergsagel et. al. (2007), Nair and Fielding (2005) and Lackney (2003)]

Key patterns	Associated design principles	Examples of architectural/design features and indicators of pattern
Personalised	Site & building organization Character of all spaces	• Human scale • Way-finding • Distributed resources • Welcoming entry • Home base & individual storage • Accessible to all abilities and mobilities
Learning-focused	Site & building organization Site design & outdoor learning spaces	• Signature (organisation's identity) • Display • Transparency (connections visible) • Varied spaces – resource rich • Studios and specialist labs • Presentation areas • Integrated technology • Indoor/outdoor connections • Cave space • Wide range of experiences
Collaborative	Site & building organization	• Clusters of learning • Gathering spaces • Casual eating areas
Community connection	Planning & design process	• Sitting in context • Well located
Adaptable and flexible	Site & building organization	• Multi-use classrooms • Learning support – furniture and storage • Flexible boundaries • Adaptable utilities • Living buildings
Neighbourhoods	Site & building organization	Central open space used in common by the classrooms surrounding this space Rooms installed with a range of operable walls learning spaces can be expanded and linked in a range of combinations
Villages	Site & building organization	• A number of neighbourhoods • Arranged around a larger common area • Circulation spine/zone
Studio communities	Site & building organization	Clusters of flexible teaching spaces Contain a range of learning modes Arranged around a communal space for larger social and learning activities Direct access to outside & common areas Self-contained elements

physical environment was not viewed as a precondition for establishing an effective learning community. Hence, the schools could still pursue their cultural goals even when the physical environment lagged behind.

The framework for my study was also informed by educational leadership theory. By focusing on the processes involved in the process of designing and constructing the physical learning environment, I anticipated the importance a school's principal would play in the process, as well as the role the principal would play in articulating the school's learning culture. There was an emerging perspective in my study that transformational leadership was one way of empowering stakeholders to use the potential of physical resources in their learning spaces to achieve and maximise learning outcomes and experiences.

In summary, four theoretical constructs provided me with a conceptual framework for investigating the relationship between students, teachers, learning and the physical environment in schools. Due to the scope and complexity of the area I was investigating, I felt it appropriate to use a number of concepts and develop a robust theoretical framework by integrating the theoretical links between architecture, learning communities, pattern languages, affordances and leadership in the context of schools.

Figure 1 draws together the different theoretical constructs into one framework. These constructs have a number characteristics in common, these being: engagement;
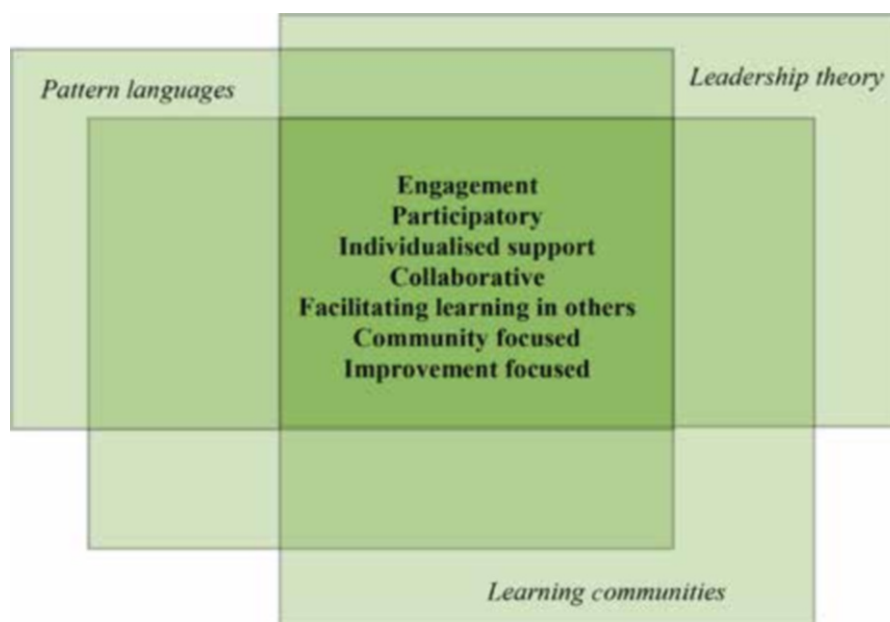
Figure 1. Common characteristics linking four theoretical constructs

109

participatory; individualised support; collaborative; facilitating learning in others; community focused; and improvement focused. It is through the lens of these common characteristics that I investigated the relationship between the learning environment and the learning culture of a school.

RESEARCH PROJECT DESIGN AND METHODOLOGY

My study posed four key research questions:

- What are the intended outcomes of school design from the perspective of stakeholders and in relation to the specific school contexts? (Stakeholders are educational leaders in the school, teaching staff, students and architects.)
- What are the key influences on the design of school architecture and use of educational facilities?
- What is the relationship between architectural and design factors and the development of an effective learning environment?
- How does the leadership in schools influence the design of physical learning environments?

I adopted a case study methodology and comprised a dataset of three cases, the first of which was also treated as a pilot study. Case selection was purposeful. The criteria for selection of each case was:

- The school must be new, which means established or "relaunched" during the past 10 years;
- The school leadership team was directly responsible or was substantially involved in the design and construction of the new school.

Leadership claims a vision for the school in line with the definition of a learning community and an innovative learning culture.

From the multiple cases I was also able to draw an additional single set of cross-case conclusions. I chose a qualitative research approach to enable me to capture the values, attitudes and preferences of participants from three different but similar contexts with the aim of permeating the "how" and "why" underlying the believed impact of architecture on the learning culture of a school.

The study used six constructed data collection activities in three cases. In the first study school (Jacaranda College), I made two sets of observations, one whole school and one focusing on a specific building project. With Grevillea College, I made two sets of observations, one whole school and one of Years 5 and 6 in the Middle School. For Acacia College, I also made two sets of observations, one whole school and one of the Year 6.

Data collection began with the participants were the staff who had the positional authority to initiate and contribute directly to the design of the college's educational facilities. Schedules of participation and the data collection visits and activities are shown in Tables 3 and 4.

Table 3. Schedule of data collection

Case study school	Documentation sent to college	Site visits and researcher observations	Interviews	Questionnaire or participant generated photographs
Jacaranda College	June 2007	Term 4, 2007 (November – December) Term 1, 2008	November 2007 – Principal, Head of Campus, Property Manager, Architect, two senior students, one teacher	November 2007
Grevillea College	July 2008	Term 4, 2008 (November – December)	27 & 28 November 2008 – Principal, Head of Middle School, Bursar, four Middle School teachers	27 November 2008
Acacia College	August 2007	August 2007 May 2008 May 2009 August 2009 September 2009	June 2009 – architect. September 2009 – Principal, Head of Junior School, College Manager, one Year 6 teacher. August 2010 – educational expert	August 2009

Table 4. Participation in each data collection activity

Data collection	Jacaranda college	Grevillea college	Acacia college	Total
Interviews	5	7	7 #	19
Questionnaire or Participant Generated Photographs	7 teachers & 5 students	32	40	84
Researcher Generated Photographs	109	106	116	331

THE CASE STUDIES: JACARANDA, GREVILLEA AND ACACIA COLLEGES

All three colleges were fully accredited and registered Kindergarten to Year 12, co-educational schools in New South Wales. Jacaranda College was situated on an 8 hectare site in a semi-rural urban area outside a major city. This college had grown

in stages according to demand from the local area. Grevillea College was situated on a single 11.4 hectare site in a semi-rural urban area.

This college had established an organisational structure that divided the students into three sections or departments called schools. Originally the plan had been for a small college with two departments called Junior School (Kindergarten to Year 4) and Middle School (Year 5 through to Year 7). As the college enrolments grew, the curriculum developed and facilities expanded to accommodate the new classes and programmes. Acacia College was situated in metropolitan New South Wales on a single 9.7 hectare site in a suburban growth area. Whilst it grew in stages, this growth had been planned.

A key aspect of my research technique was the use of a number of different lenses to observe the colleges. I employed four lenses: the visual lens of the researcher; the interview lens of the educational leadership team; the interview lens of the teachers and the interview/questionnaire lens of the students.

On my visits to the colleges, I recorded my observations of the environment in a series of photographs. These photographs allowed me to look at what was actually there from an architectural point of view. At Grevillea College, I walked through the learning spaces, at times guided by two students or the Head of School and at other times alone, recording visual aspects of the built environment through 114 photographs.

Twenty photographs displaying the greatest number of design features or the images were then selected for the questionnaire activity. The photographic data at Acacia College revealed growth that was leading the college towards a village configuration, with a number of cohort defined neighbourhoods arranged around common areas. Analysis of the 126 photographs taken in ten different areas of Acacia College revealed the use of five architectural patterns for learning: personalised, learning-focused, collaborative, community connection and adaptable/flexible. The design features most evident in Grevillea College's built environment were; human-scale, indoor/outdoor connections, campfire and watering hole spaces, gathering spaces, casual eating areas, contextual connection with local community, adaptable utilities and a limited number of multi-use classrooms. The most common patterns were personalised and learning-focused.

The educational leaders' and teachers' lenses were provided through interviews with principals, senior executives, class teachers and business staff. At Jacaranda College, two main themes emerged from these interviews. The first theme was the role of leadership in the design process and the second theme was financial factors or procurement. Leadership was explained in two ways: individual leadership and shared leadership.

The principal made the distinction between involvement that was linked to his senior leadership role and involvement that was part of a collaborative process that included other members of the staff. This point of view points to the existence of both individual and collaborative leadership roles and responsibilities in the process of designing educational facilities. At Grevillea, a number of themes emerged in the

leadership interviews, foremost being the role of relationships and access to a variety of spaces and resources.

The principal at Acacia College raised a number of factors that were echoed by other leaders in the study. He argued that the key factors with the most significant effect on design were those of leadership and the collaborative nature of the design process. The Head of Junior School emphasised a number of design features that she believed had a direct impact upon the delivery of teaching programmes, the most significant being: the amount of storage and floor space available for use within a classroom; movable walls for introducing variety into the configuration of spaces; a range of spaces for different modes of learning and delivery; and Information Technology resources.

According to Acacia's principal, leadership was at the heart of encouraging staff to use the facilities to support their teaching practices. The principal conveyed the belief that it was his role to constantly find ways of explaining the broader role of the teacher in the process of using spaces to support learning. In all three colleges, leaders were aware of their responsibility for providing effective facilities, on budget, on time and in line with strategic and master planning.

The teachers emphasised the importance of having control over working and teaching spaces. One teacher described all the modifications he had made to the classroom and concluded "It makes me feel 'in control' of my work life". Space to work and reliability of Information Technology were also factors that affected the effectiveness of teacher work areas according to some teachers. Themes of physical comfort, difficulties of sharing spaces and places to work alone by choice were common to most teachers' responses. The most extensive and complex response came from one teacher, who had recently been relocated to a larger communal staffroom in a temporary building on the campus. She photographed her current work/preparation area and placed it beside a second photograph of a closed door.

Behind the closed door was her old workspace, which she described as a "cosy office area". What she liked about the old office area was its location in relationship to the busy areas of the college and how it had provided "spontaneous rich incidental contact with exchanges of ideas and sharing of work". She now felt lonely and isolated. For her work as a teacher, relationships were vital and having control over her workspace was also important for maintaining the type of contact she needed. She reflected on the notion that hubs of collaboration do not always develop in official or designated places.

At Grevillea, class teachers emphasised the themes of space and belonging to a place and the role relationships play in the learning process. Physical comfort, flexibility and variety in spaces were emphasized as being crucial to the learning environment. However, the single most frequently mentioned issue in the teacher interviews was access, and in particular, distribution of integrated Information Technology resources. At Acacia College, teachers were particularly concerned with creating inclusive, flexible, autonomous learning spaces.

For students the factors that had the most influence on the relationship between the physical environment and learning were physical comfort, access and inclusion. Having enough space to remove distractions and having choices in the place where you work were also underlying factors. Commonly mentioned negative factors were related to insufficient space, storage and physical comfort. There was no gender difference for these factors.

At Jacaranda College, outdoor areas were photographed as choices for learning environments that could provide relaxing, calm work areas or room to move. In contrast, feeling cramped inside was something a number of students raised as a negative. Photographs showed chairs squeezed between fixed rows of desks, carpet caught around chair legs and rooms crowded with furniture.

Students at Grevillea College emphasised a homeroom or the library's lounging area as the most preferred places for talking quietly with a teacher about work. According to the questionnaire, one of the most frequent reasons for students choosing a particular place was related to physical comfort. Factors like uncomfortable furniture, climate control, distractions and overcrowding were named as making it difficult to learn in the classroom. Relationships and different types of belonging, such as my own desk or our classroom, mattered from the student perspective.

One significant difference between the student and teacher perspectives was the narrow range of factors mentioned by students compared to their teachers. Students used fewer thematic categories and emphasised features relating physical comfort, space and personal belonging. Teachers used multiple thematic categories and emphasised information technology, belonging to a community, flexibility and space. I would argue this difference related to the role each participant played in the learning relationship. In all of the colleges, it was recognised that some of the effectiveness of the learning places was actually achieved by teachers modifying and adapting spaces with whatever resources were available. In all three colleges, the most intensely areas were those that provided flexibility, adaptability, access and space for storage and movement.

KEY FINDINGS AND IMPLICATIONS FOR RESEARCH

This study found learning environments are affected by affordability, time constraints, master planning, the inclusiveness of the design process, the roles the various stakeholders take in the design process and how space is interpreted and valued by each stakeholder. The key findings are summarised in the following table:

The study found the intended outcomes of school design from the perspective of stakeholders and in specific school contexts were:

- Comfort and wellbeing (teachers and students in particular)
- Community relationships
- Supports and reflects school culture
- Facilitate curriculum

Table 5. Main findings of study

Key question	Main findings	Source of findings
1. What are the intended outcomes of school design from the perspective of stakeholders and in relation to the specific school contexts?	Comfort and wellbeing (teachers and students in particular) Community relationships Support/reflect school culture Facilitate curriculum Space to carry out teaching and learning activities (teachers in particular) Flexibility and adaptability (school leadership and designers in particular) Affordability (school leadership in particular)	Document reviews Interviews (educational leaders, teachers, students) Architect's interview Researcher observations Questionnaire
2. What are the key influences on the design of school architecture and use of educational facilities?	Change agendas Embedded school culture Curriculum Constraints, compromise and processes for negotiations School context Affordability School growth (time and urgency) Approaches to master planning Structural organisation of school	Document reviews Interviews (educational leaders, property managers, teachers) Educational consultant's interview Architect's interview Participant Generated Photographs
3. What is the relationship between architectural and design factors and the development of an effective learning environment?	Relationship does not cause development of an effective learning environment. Design and architectural factors more likely to operate as preconditions for developing the learning environment. Creating learning communities was affected by scale, existing or envisioned learning culture, cultural emphasis upon community relationships, opportunities to create communal and personal space within a classroom and access to a variety of learning spaces. Factors identified as being influential in developing effective learning environments: People who use the spaces have control over the environment Access to resources (especially I.T. Flexibility Sufficient physical space to deliver the planned curriculum Site/master planning	Document reviews Interviews (educational leaders, property managers, teachers) Field observations, site visits, photographs Questionnaire Participant Generated Photographs

Table 5. (Continued)

Key question	Main findings	Source of findings
4. How does the leadership in schools influence the design of physical learning environments?	Principal identified as central to the entire process of building the physical learning environment. Principal identified as playing key role in embedding learning culture and leading change. Collaborative processes involving stakeholders identified as crucial for achieving best design.	Site visits Interviews (educational leaders, property managers, architect, educational consultant, teachers)

- Space to carry out teaching and learning activities (teachers in particular)
- Flexibility and adaptability (school leadership and designers in particular)
- Affordability (school leadership in particular).

The key influences on the design of school architecture and use of educational facilities were:

- Change agendas
- Embedded school culture
- Curriculum
- Constraints, compromise and processes for negotiations
- School context
- Affordability
- School growth (time and urgency)
- Approaches to master planning
- Structural organisation of school.

Design and architectural factors were more likely to operate as preconditions for developing the learning environment. The creation of learning communities was affected by scale, existing or envisioned learning culture, cultural emphasis upon community relationships, opportunities to create communal and personal space within a classroom and access to a variety of learning spaces.

Factors identified as being influential in developing effective learning environments were:

- people who use the spaces have control over the environment
- culture that built relationships
- access to resources (especially I.T.)
- flexibility
- sufficient physical space to deliver the planned curriculum
- site/master planning.

Both students and teachers identified space and Information Technology resources as being important. Students emphasised features that created physical comfort and access to outdoor areas, and many students described comfort as being free from distractions, especially distractions created by other peoples' behaviour.

Students emphasised access to outdoor areas because these environments offered solitude, fresh air, a pleasant ambience, variety, room to be physical and an opportunity to engage in informal activities. These features agreed with characteristics the design literature identifies as what matters the most in terms of adequacy and post-occupancy satisfaction.

The key factors that contributed to building communities were control and a culture that valued relationships and fostered a sense of belonging to a community. The staff and students at the case study schools valued personal relationships as a foundational principle of their school culture. What followed was a belief that learning was based upon positive relationships, especially between the teacher and learner. Consequently, factors that had an impact on this relationship became significant in the process of designing effective learning environments.

Leadership in schools influenced the design of physical learning environments. As anticipated, the principal was identified as central to the entire process of building the physical learning environment. The principal was also identified as playing key role in embedding learning culture and leading change. The principals' interviews indicated they were optimistic about the potential for their schools to grow and change in the years to come. Collaborative processes involving stakeholders were identified as crucial for achieving best design, even if they were not necessarily followed in the case study schools.

An unexpected finding was the need to understand the relationship between learning environments and those who use those environments (in particular, the teachers and students) in terms other than the language of architectural design. This led me to consider the articulation of the relationship between the environment and learning from the central perspective of the student (see Figure 2) that places the learner at the centre of a dynamic relationship with the learning environments using the notion of affordances rather than pattern languages.

This theoretical model is a way of understanding how potential affordances can be designed into that environment and how the affordances can be perceived and then actualised by the student within the context of a learning community. The model also shows how pattern languages and affordances can work together. I came to the conclusion that the concept of pattern language provides a language for the construction of the physical space and the theory of affordances can explain how students and teachers see and use the spaces after construction. Both describe a person-environment system and are relational concepts.

The pattern language articulates what is present in the human-environment relationship as a result of design and affordances are situated between the individual and the environment without being a characteristic of either of them alone. Finally,
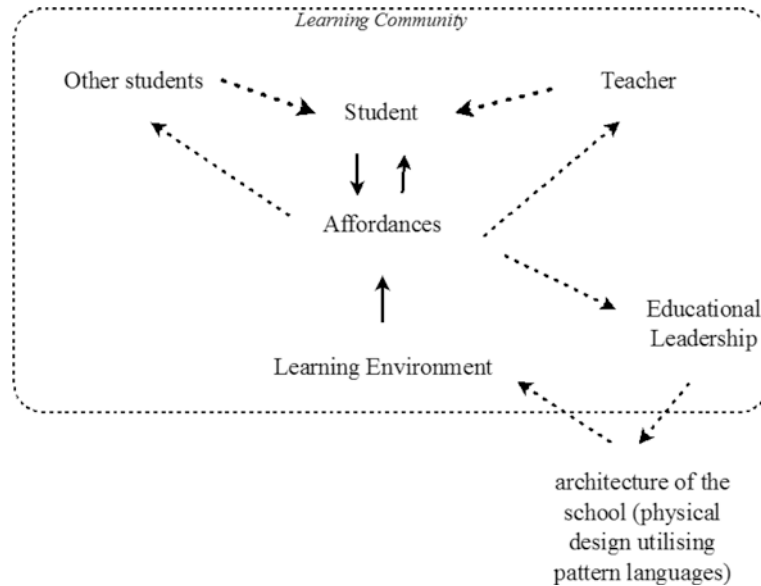
Figure 2. The student's relationship with the affordances of the learning environment

the model shows the student's daily interaction with the environment taking place within the culture of a learning community.

The findings of this study lead me to make a number of recommendations for practice, policy and further research. Key recommendations for current practice and policy are:

- to ensure more master planning of the design of a school takes place from the outset;
- greater flexibility in the design of facilities in response to a school's context;
- increased teacher professional development in the area of using space as a part of pedagogy.

A significant recommendation for both policy-makers and practice is to allow a school's context and key stakeholders to play a significant role in the design of the physical environment. This study's findings lead to the conclusion that greater flexibility when responding to contexts will improve the fit between the physical environment and learning culture within each school. Improving each school's approach to master planning could provide the opportunity of constructing the physical environment in stages whilst still achieving a cohesive design for the entire school.

The findings of this study also point towards a need for increased research into school design within the Australian context. Since context is influential in the design of a school, it is reasonable to argue that the national context would have an influence on school design and current studies of Australian schools are not numerous. Understandings of the relationship between the physical and learning environments would be enhanced by longitudinal studies that could investigate the long-term impact of early 21st Century designs on school learning culture, learning outcomes and the establishment of learning communities within schools.

CONCLUSION

In conclusion, this study confirmed the belief that school design matters in a profound way to all the stakeholders, and in particular, to the teachers and students. The relationship between the physical and learning environment is complex and at times chaotic. The context of a school has a significant effect upon the design process and the development of the physical environment. The school culture also has an impact on the way in which community is built.

The issue of compromise, the impact of master planning, the nature of educational leadership and the constraints of affordability and time had a profound impact upon the design of schools. The study identified a number of features within the learning environment that were seen as contributing to learning communities and effective spaces.

This study also found the most enduring influences upon the relationship between the built environment and learning are dynamic in nature. The relationship could also be understood as a constant dialogue or interaction between the people, the purpose of schools and the places where this purpose is achieved. The relationship between leadership, the built environment and learning focuses on the classroom and what happens between teachers and their students.

It is a problematic relationship since each group involved in the process of constructing educational facilities, as well as those for whom the facilities are built, look at physical spaces from different perspectives. These perspectives are framed by the different functions these groups see the physical spaces as fulfilling. These groups may even frame their perceptions using different languages. The relationship is both affective and physical, it involves both the practical function a space fulfills as well as its symbolic role.

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119

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6. ALIGNING LEARNING ENVIRONMENT AFFORDANCES FOR EFFECTIVE PROFESSIONAL LEARNING IN AN INNOVATIVE SENIOR SECONDARY STEM SCHOOL

INTRODUCTION

A shortage of graduates in science, technology, engineering and mathematics (STEM) disciplines has been reported internationally with the Australian Industry Group (2013) noting that STEM skill shortages are limiting business and opportunities to innovate and – with the growth in technology and its ubiquitous use world-wide the STEM skills shortage – will become even more evident. The report also states, "Young people in schools and universities are not acquiring the STEM skills we need for our future prosperity."

The Australian Chief Scientist Professor Ian Chubb (Commonwealth of Australia, 2012) identified that to increase suitably qualified STEM professionals a transformation in the way science and mathematics is taught in the primary and secondary year of schooling is required. But to transform science and mathematics teaching Chubb and his colleagues acknowledged an urgent need to increase the pool of inspirational teachers with extensive STEM discipline knowledge and that STEM teachers required access to high quality professional learning that incurred no individual financial burdens.

They also recognised the importance of other factors in achieving an increase in highly qualified STEM teachers including the role of school leadership and university partnerships.

Chubb's report reflected previous research including the recognition that science and mathematics education in Australian senior secondary years of schooling has experienced declining enrolments, negative students' attitudes, a shortage of qualified teachers and a curriculum that lacks relevance to contemporary life (Masters, 2006; Smith, 2003; Tytler, 2007). Such evidence called for transformation in secondary science and mathematics education and acknowledged that teachers' professional learning was central to achieving the required transformation.

In responding to such evidence Flinders University in Adelaide, South Australia in collaboration with the South Australia Department of Education and Children's Services embarked on a bold initiative to design a purpose-built mathematics and science focused school on the campus of the University. The highly innovative

school would cater for senior secondary students only (Years 10–12) and employ cutting edge interdisciplinary curriculum developed by teachers and academics working in collaboration. Pedagogical approaches would draw on deep knowledge of effective learning processes with specific attention to inquiry-based learning.

The school day would not reflect the traditional school model of 8 periods of 40 minutes per discipline-based lesson with students divided into year levels. Rather learning would occur in extended blocks of time and students in Year 10 and 11 would be grouped together to undertake 6 interdisciplinary studies across a full year (3 per semester). The school, eventually named the Australian Science and Mathematics School (ASMS), was also unique and innovative in the design of its learning environment and the impact of this environment on the learning culture for teachers and subsequently students is the major focus of this chapter.

Marshall (2009) called for STEM education that would generate students who were "disciplinary, creative, innovative, entrepreneurial, integral, and wise" (p. 49) and this is reflected in the ASMS context statement (2013):

> The ASMS will be recognised for its leadership of innovation and reform of learning and teaching in science and mathematics. The ASMS is constantly in the process of creating a learning environment for the future that will prepare young people with a passion for study in science and mathematics to be creative, critical, informed and motivated contributors responding to professional, personal and social issues.

The context statement captures once again the focus on 'creating a learning environment' to not only engage the students but to encourage students to aspire to careers in mathematics and science. The 'learning environment' was a combination of the physical learning space and the creation of a learning culture. Davies, Heath, and Bissaker (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)

This statement reflects that the initial design of the school was focused on generating a learning environment prioritising students' learning but teachers were also significant beneficiaries of the building's design even though this was not initially evident to them. Aspects of the building's design and its influence on the teachers' learning are also addressed in more detail hereunder. However, the focus here is on how teachers have influenced the design of the building and hence the narrative focuses on teacher-led transformative pedagogy which is a fundamental precursor to any changes in design.

In essence the Australian 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. Those who founded the school recognised the critical nature of teachers as learner to achieve the vision of the school and stated:

> The Australian Science and Mathematics School has a vision to provide a learning culture for its students that derives from a learning culture developed by its staff from their interaction with university and industry scientists and educators. (School policy statement, 2003)

HIGHLY EFFECTIVE LEARNING CULTURES: RESEARCH FINDINGS

Significant research has occurred in the previous decade to identify the feature of highly effective professional learning and learning cultures that teachers' report makes a difference to their knowledge and practice. McRae et al. (2001) promoted the concept that teachers' learning should be continuous, a daily event and situated within the workplace. They cited Retallick (1997) who made a distinction between professional development that involved attending workshops, seminars and off-site programs and site based learning involving daily opportunities to learn that are based on the current work of teachers.

Retallick (1997) argued, "What is required is not so much a change of culture in schools, but a recognition by the teaching profession that professional learning can and does take place on-the-job and in the workplace of teachers when problems and difficulties are seen as learning opportunities" (p. 23, cited in McRae et al., 2001). Fullan (2007) supported this concept and called for a distinction to be made between professional development and professional learning. He advocated that the term professional learning should replace development so that a renewed focus on the conditions for powerful learning is achieved. He stated:

> Professional development as a term and as a strategy has run its course. The future of improvement, indeed of the profession itself, depends on a radical shift in how we conceive learning and the conditions in which teachers and students work. (p. 35)

He also argued that professional learning communities provided one of the best options for engaging teachers in learning as a daily event. The designers of the ASMS's physical and cultural environment reflected Fullan's concepts and the conditions in which the teachers at the ASMS worked provided rich opportunities for engaging in learning on a daily basis.

Easton (2008) also stressed the need for schools to move beyond the paradigm of teachers being 'developed' via external professional development programs to a model whereby teachers view themselves as 'active learners' embedded in an environment that provides significant opportunities for learning. Easton contends that:

Developing is not enough. Educators must be knowledgeable and wise. They must know enough in order to change. They must change in order to get different results. They must become learners, and they must be *self*-developing. (p. 756)

However, to become 'self-developing' a combination of teachers' dispositions and the contextual conditions in which they work prove critical to the potential for learning and the outcomes of the learning. The ASMS recognised the interplay between the teachers and the contextual condition as fundamental to learning outcomes for the teachers and subsequent learning outcomes for students.

Desimone (2009) in her meta-analyses research on evaluating the effects of professional [learning][1] on teachers and students proposed that for high quality outcomes to be achieved core features must be present. She identified clarity of the professional learning content focus as a core feature. At the ASMS content foci developed and shifted over time but included a sustained focus on understanding learning and learning processes, the purposes for and characteristics of high quality interdisciplinary curriculum and cutting edge science and mathematics. The other core features of Desimone's model were more processes oriented and included a collective group of active learners participating in a coherent program conducted over time. She highlights that although the model is viewed as:

Nonrecursive [with] interactive pathways [this] does not prevent differential emphases on either the basic components (professional development, knowledge, practice, and student achievement) or the addition of moderating and mediating elements such as teacher identity, beliefs, and perceptions. (p. 185)

Figure 1 provides an overview of how these core features contribute to change in teachers' knowledge skills and beliefs and the subsequent influence on student learning. As noted in the figure, Desimone acknowledges that there are several underlying factors that also influence the outcomes of professional learning including teacher and student characteristics, leadership, curriculum and policy. These moderating and mediating elements were all of significant relevance to the ASMS context.

Desimone did not determine whether her model reflected school-based or external professional learning but the elements of the model reflected well the conditions evident at the ASMS. However, the design of the ASMS and the bold vision to base its innovation on teachers' professional learning is unlikely to be reflected in Desimone's meta-analyses on the effects of professional learning on the design of schools.

As such the ASMS provided an ideal research opportunity to capture what Desimone reported as 'rare', the ability to document and acknowledge all elements, particularly those moderating and mediating influences evident in her model. She called for research that:

> … provide[s] narratives, examples, and anecdotes to answer research questions directed at questioning models of teacher interactions; generating hypotheses; and describing and understanding the complexities of professional development in a specific context, how beliefs and attitudes change, and the process through which teachers change their instruction. (p. 190)
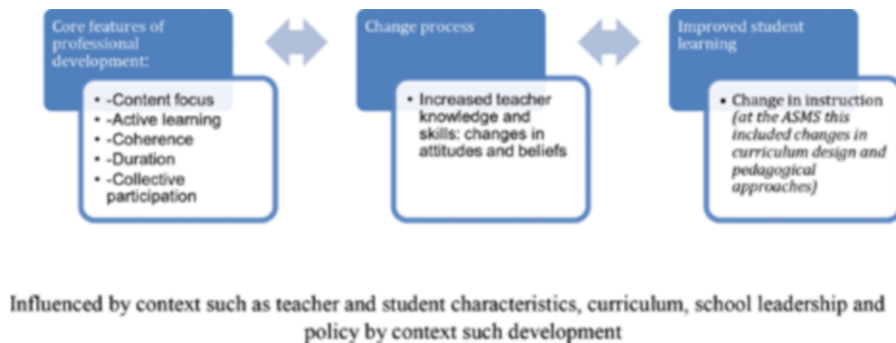
Figure 1. Desimone's (2009, p. 185) conceptual framework for studying
the effects of professional development on teachers and students

This research was designed to capture what Desimone acknowledged as an ongoing and important gap in the research literature on powerful professional learning for teachers.

THE RESEARCH PROCESS

The research was conducted over a period of seven years and grounded theory methods were used to answer research questions about what supported and sustained teachers' learning in this innovative context and the outcomes of teachers' learning for teachers, students and the school. To achieve an authentic account of the teachers' lived experiences I positioned myself as an insider-researcher working intensely and thoughtfully with staff at the ASMS.

The analysis and interpretation of a range of data (including interviews, observations and open-ended surveys) collected over an extended period of time supported the development an in depth understanding of the interactions between contextual conditions, organisational elements and relationships factors that provided a context for and enabled teachers' professional learning.

An explanatory model of professional learning that reflected the complexity of the many elements alluded to by Desimone but not able to be captured in her research was developed as an outcome of the theorising process. The model identified the importance of alignments between teachers' capacities, characteristics and sense of personal agency and specific contextual conditions, organisational elements and relationship factors. A full account of the model's development can be located in Bissaker (2010); however, this chapter focuses more specifically on the influence of the physical environment on teachers' learning and the culture of learning in general. There was clear evidence from the research that many 'contextual' factors beyond the building's design including the school's philosophy and vision, the leadership, colleagues, interdisciplinary curriculum writing teams and the school-university partnership were all instrumental in generating a powerful learning culture.

The research reported in the original thesis on which this chapter is based (Bissaker, 2010) captured the complex interactions between contextual conditions, organisational elements and relationship factors in generating an environment for daily high quality professional learning at the ASMS. In addition, it acknowledged the dispositions of teachers and their sense of personal agency as a fourth element of significance in the professional learning model.

The model captured the interactive nature between these four areas noting the importance of the many incidental and intentional learning opportunities generated through the alignment of teachers' learning interests and needs and the conditions for learning present as an outcome of the physical and cultural environment of the school. These alignments were many and varied but fundamental to high quality daily professional learning for all teachers at the ASMS. The alignments were ultimately identified as affordances.[2]

<div align="center">AFFORDANCES</div>

The term affordance is used as a noun to identify the relational aspects of the actor and their environment; in this research being the teachers and the school's design and organisation. James Gibson (1977, cited in Wenger, 1998), initially used the term to define the many possibilities of action when an actor interacts with an environment. Gibson provides the examples of a human coming together with a set of stairs as providing an affordance for climbing, similarly the claws of a squirrel and tree also provide an affordance for attaining a goal.

An affordance is generated when the environmental conditions match well with the actor using the environment to achieve a goal. The concept of affordance has generally been associated with the properties of an evironment or object in the environment. Initially this may be thought of as the physical enivornment but in this research it became evident that the cultural environment created through the schools' context and organisational elements also acted as affordances for learning. McGrenere and Ho (2000) in an attempt to clarify the definition of an affordance highlighted that:

> Gibson describes the environment as being composed of nested objects and he describes the nesting of information that specifies affordances but he never specifically uses the term nested affordances. (p. 2)

McGrenere and Ho's use of the terminology 'nested affordances' to describe connections between objects and information fits well with the outcomes of the research on affordances for learning at the ASMS. For example, although the design of the school clearly acted as an affordance for learning it might have also worked against the learning of those teachers who felt anxious about their teaching practices being consistently on 'display'.

For the physical environment to act as an affordances for the majority of teachers in the school a 'nested' affordance associated with the cultural and organisational enviroments also needed to be in place. In this sense, attention to the generation of building trust and respect between teachers through providing time and space for teachers to work in interdisciplinary curriculum writing teams and team teaching situations were acknowledge as affordances for teachers' learning.

Another important understanding of the affordance concept, and of particular relevance for this research project was Gibson's notion that an affordance can exist independent of the individual's ability to perceive this possibility (McGrenere & Ho, 2000). This concepts suggests an individual may not acknowledge a specific affordance as being of influence to their attainment of goals. They may either see themselves as in control of such outcomes or fail to acknowledged the 'nested' nature of affordances that contribute to achieving desired outcomes.

For individuals working in enviroments much reflection is required before they may start to conceive of the many affordances that have contributed to the achiveing of preferred goals. This research provided many opportunities for teachers to consider what influenced their learning, in additional extensive observations were made of teachers teaching and learning in the ASMS environment. This data provided ongoing opportunity over a seven year period for developing a deep understanding of the many obvious and less obvious affordances for teachers' learing.

Affordances for learning at the ASMS were varied and in abundance. They were at the very heart of processes that allowed teachers to learn individually and collectively. However, as Wenger (1998) said, "one can produce affordances for the negotiation of meaning, but not meaning itself" (p. 229). Wenger also claimed, "Learning is first and foremost the ability to negotiate new meanings: it involves our whole person in a dynamic interplay of participation and reification." (p. 229). In essence Wenger identified that "learning is a matter of alignment" (p. 228) which depends on learners connecting their inner understandings and perspectives with learning opportunities presented to them preferably in ways that direct energies to the common purpose of the learner and the organisation. This connects well with Gibson's view that an affordance reflects mutuality between the actor and environment.

Figure 2 provides an overview of the interaction between the enabling contextual conditions and alingment for learning that is created when these fit well with teachers'

individual goals, beliefs, capacity and sense of personal agency. The very diverse nature of teachers as individuals immediately illuminates the need for diversity within the enabling conditions as well and examples of these alignment will shared in the outcomes section of this chapter.

Figure 2 also highlights how the outcomes of the teachers' learning influenced both the enabling conditions and their individual dispositions. In this sense teachers were shaped by what they brought to the learning environment and by the nature of the learning environment but they also helped to shape the growth of the environment and themselves. This iterative and generative cycle proved critical in sustaining a rich learning culture over time.
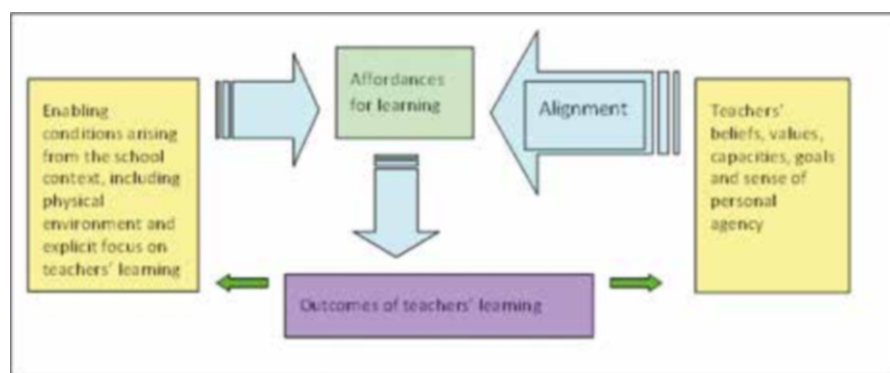
Figure 2. Factors that contribute to creating affordances for teachers' learning

THE SCHOOL'S ENVIROMENT AND ITS IMPACT ON PROFESSIONAL LEARNING

"The opening day of the year with the balloons and everything was such a surprise to me … I mean for the past 10 years I have been walking into schools and commiserating with the students about being back at school … it's a different feel altogether here, you want to be here" ASMS teacher reflecting on the first day in the school's second year of operation.

"There's no boundaries here – in the building, or to our learning" Student quoted in the Evaluation of the Higher Education Innovation Programme at the ASMS. Australian Council for Education Research, May 2005.

These reflections from an ASMS teacher and student indicate the school provided a learning and cultural environment that was highly valued by the key stakeholders. Both make explicit reference to the physical elements of the learning space, some generated by the building design the other (balloons) an element added to the space

by the people using the space. The following section provides an overview of the learning space and examples of how it was used.

The 4000 square metre building was constructed over two levels. Figures 3 and 4 are basic floor plans of the building and these have been included to gain a sense of the difference in architecture from more traditional schools. The building featured large open-space teaching areas called learning commons (LC). The 9 LC were approximately 160 square metres in size. Every LC provided workstations and storage lockers for approximately 50 students. The building was designed to accommodate a maximum of 450 students but in flexible ways.

The LC provided a "home space" for groups of students. One teacher supervised the groups of students, between 10 and 15, and up to three groups would share one LC. The groups were known as tutor groups and would meet daily. The openness of the LC allowed for staff and students from a number of tutor groups to interact and support each other. The LC also provided the key teaching areas and 3–4 different teaching and learning groups might be in action at any one time, or alternatively, 2–3 teachers within one LC may manage one large group of students.
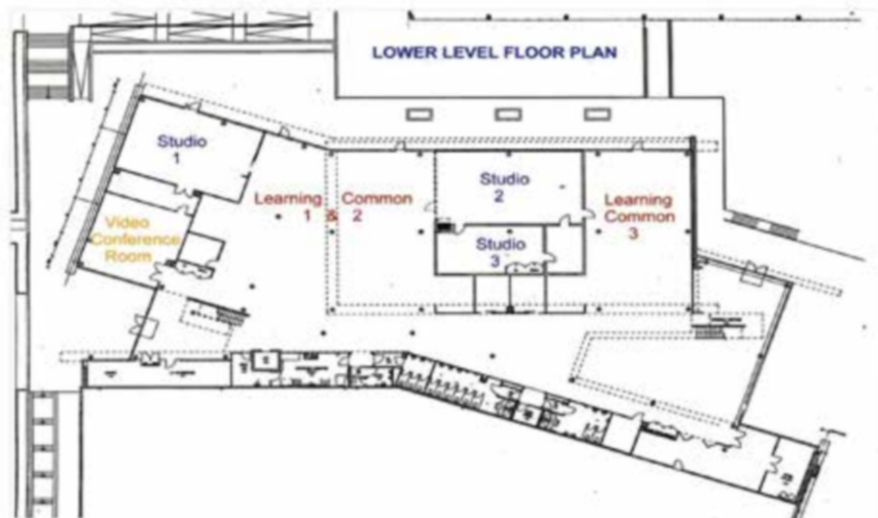
Figure 3. Lower level floor plan
(ASMS school planning archives, 2003)

The furniture provided in the LC allowed for lecture style seating, chair and table layout, larger tables for group work and combinations of all three. Electronic whiteboards, data projectors, overheads and display screens were available in two strategic fixed locations with 30+ computers and mobile teaching platforms

133

(which provided access to DVD/Video players and large flat screen televisions) also available in most LC.

The building also incorporated a series of learning studios as replacements for the more traditional school laboratories. The studios, all leading off the learning commons, were divided by transparent glass walls and sliding doors. The intended effect was to create a learning space where all student and teacher action could be readily observed and where there was a sense of connection between locations. The studios were designed to cross the boundaries between traditional disciplines and promote an interdisciplinary platform for learning.

There were nine learning studios with varying names including Human Performance, Video Production, Physical Sciences, Applied Technology, Life Sciences, Environmental Science and Mathematics. No one teacher had responsibility for any particular learning studio as they were used when relevant to the learning needs of students.
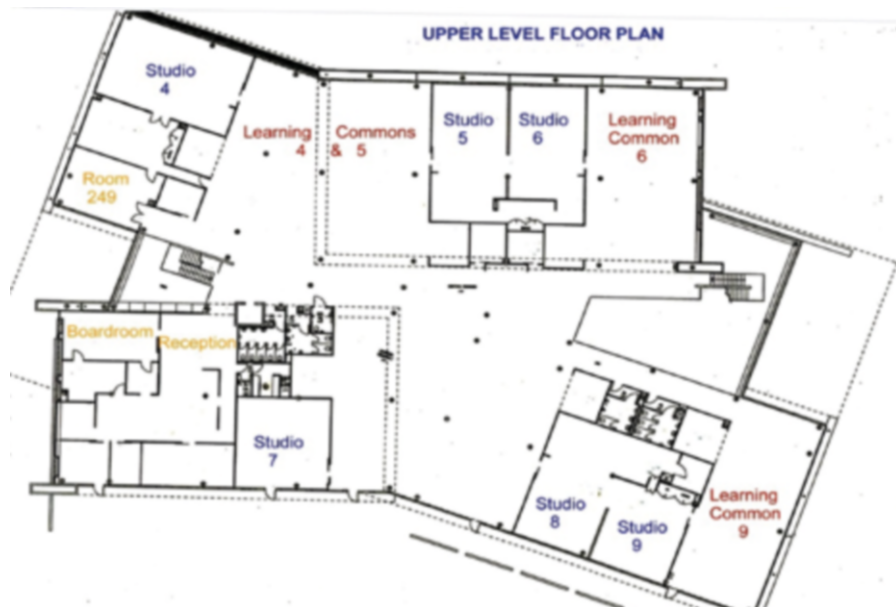
Figure 4. Upper level floor plan
(ASMS school planning archives, 2003)

Another key feature of the building was the Central Common. The architectural brief (ASMS School Planning Archive, 2003), said "the central internal space links all the functional spaces to promote a sense of community within the school … it provides a strong visual identity with an impressive two-storey space with raking ceilings and roof lights and larger areas of glass, … and a flexible gathering space for 250" (p. 14).

The space has been used for a diverse range of functions including many conferences. These conferences attended by local, national and international educators and professionals are conducted in the same space as students attending classes. The outcome of adults and students working together in time and space contributed further to the "learning culture" of the school. The building design was fundamental to promoting teachers' and students' learning and to the sense of a dynamic and generative learning culture.

To extend the notion of students and teachers working and learning together the building did not provide staff preparation or faculty offices. Teachers' working spaces were distributed throughout the building and located off the learning commons. Two to three teachers shared these spaces. Teachers were constantly visible to students as they engaged in preparation, research, marking, discussion with colleagues and so forth. During teachers' non-instructional time they were in a position to observe and hear the learning and teaching occurring in the learning commons adjacent to them which provided an obvious affordance to teachers' incidental learning.

The affordance specifically linked with the learning environment at ASMS was that of *physical proximity* and its influence on teachers' learning is discussed in more details shortly.

The flexibility of the furnishing within the learning spaces provided numerous opportunities for teachers and students to create specific and varied learning environments. The building provided quiet and withdrawn learning spaces for 1–2 people through to larger open spaces that could cater for over 300 people attending a key-note lecture. Such flexibility allowed for many different teaching and learning configurations from one teacher working with individuals and small groups through to another lecturing to a group of 200+ students.

It was common to walk through the building and not be aware of which teachers were responsible for which group of students. There were always teachers "on the floor" in the learning commons and teachers working in the teacher-area alcoves. Teachers often worked in more traditional ways as well, for example, leading a group of students as they introduced new concepts or assignments. Other teachers in the same vicinity not specifically engaged with students were always available if students needed clarification about anything.

Students also made interesting use of the environment. They could be found in larger classes in the LC, working in smaller groups in glass-walled rooms located off the learning commons, or studying individually on the long flat benches that were strategically located throughout the building. At times students appeared to be "resting" or opting out of more formal learning processes but it often came as a surprise to visitors and close observers that such students were actually engaged in learning and had merely chosen a more relaxed way for the body to do this.

The extensive use of glass and open walled spaces significantly reduced the wall space available for displaying student work or teaching resources. However, the material mounted on walls was strategically selected for its explicit focus on learning and to remind students what the school was all about. Posters featured

learners such Einstein commenting, "It's not that I am so smart it just that I stay with problems longer"

The differences between the learning space of the ASMS and more traditional senior secondary schools were clearly evident. The open design was complemented by the significant availability of current technology including computers, smart boards, display monitors, mobile platforms incorporating DVD players, large digital televisions and sound systems. The school had a wireless network and many students brought their personal laptop as their primary learning resource.

The students' work was kept in e-portfolios instead of lockers and could be accessed by parents through the school's portal system. Students' preferred technologies of mobile phones and ipods were incorporated, rather than excluded from the learning environment.

There is much evidence that the ASMS reflected the high-quality learning environment that Malaguzzi (cited in Palsha, 2002) called for in Reggio preschools. Gandini (2002) described Reggio environments as "an amiable space", an environment that:

> conveys the message that this is a place where adults have thought about the quality and the instructive power of the space. The layout of the physical space is welcoming and fosters encounters, communication and relationships. The arrangement of structures, objects, and activities encourages choices, problem solving and discoveries in the process of learning. (p. 17)

Gandini's description of Reggio environments sat well with what was found at the ASMS and there was no doubt that the learning space reflected Malaguzzi's ideas of an environment that amplifies learning opportunities and outcomes for both students and teachers.

Alignment of the learning environment affordances for teachers' learning. The design of the learning spaces at the ASMS clearly promoted *physical proximity* and connectedness among the learning community. Physical proximity was identified as an affordance for learning in the previous section but the flexibility and interactive nature of the building design were also fundamental to both intentional and incidental learning for students, teachers and others who were visiting the school.

Teachers in the school made the following observations of how the design of the building acted as an affordance for their learning:

> I think this building has been one of the biggest contributors to my learning purely because you can't escape … it's the open nature, I can just sit at my desk and someone will walk past and I'll think what's he doing ... oh that is interesting … I never thought about doing it like that … even if it's just a small idea or activity.

> I saw "James" teaching this unit I had designed the other day and was so surprised as I had never considered introducing it the way he did, I just sat back and watched and listened and it really opened my eyes to a new way of doing it.

It's the environment … I haven't really invited other teachers into my classroom in the past … so even though I had good relationships with them we didn't look towards team teaching and really working together … it just seems the natural thing to do here.

It's often the case that you attend a conference where someone will say that they have something really interesting in their class and they describe what they have done. At the time you think that this is a marvellous idea and that you will go and try it yourself. You return to your school and lock yourself away in a little box of a room and very little changes. Here, because of the open nature of the building and the collaboration that occurs it is very easy to see others have done those marvellous things and to be encouraged to try them for yourself.

It is interesting to note that the teachers' comments while focusing on the environment as an affording factor in their learning, all made links to learning from another person in the environment, not from the environment itself. The role of *teacher colleagues* and *students* in the environment were identified by teachers as affordances for learning but it is important to note they may not have 'seen' these colleagues or students if they were isolated more traditional classrooms, staffrooms or faculty preparation areas.

A common complaint from teachers in more traditionally designed schools is the lack of opportunity to observe colleagues in action. The opportunity to spend time watching others teach is acknowledged by teachers and researchers alike (Easton, 2004; Darling-Hammond & Sykes, 1999; Guskey, 2000; Hawley & Valli, 1999; OCED, 2009) as a powerful form of professional learning which in traditional schools is often hard to embed within daily life. Space, time and costs often restrict teachers' opportunities to learn from colleagues in action. At the ASMS, teachers were afforded the opportunity to observe their colleagues while they were working.

Many commented on the small things they noticed others doing while they were teaching. For example, one teacher said, "I noticed [Larry] using this really interesting picture in a maths class so when I finished teaching … over lunch he told me all about it." There were numerous examples of this, all made possible by the design of the building although as Wenger identified the building provided the opportunity for the negotiation of new meaning but the teachers were in charge of what they noticed within the environment and how they made meaning from this (Moon, 1999).

Teachers in their non-instructional periods were sitting adjacent to classes in action and therefore provided with ongoing opportunities to 'notice' what others were doing, both students and teachers. In general, the 'noticing' occurred when something was relevant or of interest to the teacher. Teachers responded in various ways, for example, by thinking, "that's interesting … I might talk with [Mike] more about that later." The noticing triggered more intentional plans from an incidental beginning.

Alternatively, they responded, "that's interesting … I never knew that," with the new information stored (successfully or unsuccessfully), but with no further plan to follow up on that learning with the colleague. Such possibilities were well supported by the design of the environment but also demanded the teachers have a learning 'headset'. Teachers' personal characteristics and capacities influenced how they engaged with the environment and therefore learning was afforded by a combination of physical proximity and teacher-located factors such as openness, motivation, purposeful listening and so forth.

Teacher colleagues and students were critical elements in the environment that added to the quality of teachers' learning. However, there were also features of the environment that presented opportunities for learning in their own right. The ASMS was a technology rich environment and this also influenced teachers' learning.

The following teacher reflection highlighted that the availability of technology influenced both content and pedagogical knowledge learning:

> Its definitely the fact that we're using computers extensively that's causing this [new learning], it means that we both write the uses of computers into our materials and we also use computers for just about everything, our databases, our intranet and so on. There's a fair bit of learning going on there for teachers and students …

Learning about, and how to use, the available technology was often planned for. Teachers engaged in professional learning sessions run by colleagues or an outside facilitator but it was through the ready availability of the technology that teachers had the opportunity to 'practise' new skills and 'play around' with options before including such ideas in their teaching. The newness and reliability of the system encouraged teachers to make extensive use of technology as a tool for their own and student learning.

In addition to the extensive availability of technology to support learning, the ASMS was located within a university. This provided sustained access to the university laboratories (both indoors and outdoors) and a library full of texts and references on a range of disciplines and pedagogical research. There was also the opportunity to attend university events and more importantly meet with university partners over morning tea breaks without the need to drive long distances after work hours or taking extensive time away from the school.

The school was designed for adult learning both within the school walls and in its location on a university campus. Many staff ultimately enrolled in university courses based on its physical proximity which added a structured and specific support for teachers' learning.

In essence, the physical nature of the learning space with its rich ICT resourcing and location on a university's ground provided tangible affordances for teachers' learning. However, the responses from teachers about what supported their learning identified a range of other less obvious affordances which linked more specifically to the cultural environment of the school. These affordances included the school's

vision and innovative organisation, interdisciplinary curriculum writing teams, supportive leadership and an explicit professional learning strategy which engaged all staff in group research projects focused on pedagogical practices.

The outcomes of teachers' learning for teachers, students and the school as a learning organisation were thought of as:

> … a combination of the environment and the vision of the leaders which has been adopted and re-created by the teachers so that the ASMS emerged as a cultural environment … where everyone leads learning. (ASMS teacher)

This teacher's reflection ascertained that the vision of the school was adopted and re-created by teachers which resulted in a generative learning organisation that represented much of what has been called for in the research literature, including schools that prioritised time for teachers' learning, problematic discourses, leadership for learning (by all) and engagement with experts from the broader community (Caldwell, 2008; Darling-Hammond & Richardson, 2009; Fullan, 2001, 2007; Hargreaves, 2003; Pace Marshall, 2006; Postholm, 2012; Timperly et al., 2007).

As this teacher and others in the school and the broader research community acknowledged interactions between and alignment of affordances within the learning environment are pivotal to the quality of professional learning outcomes. And these outcomes were of influence to not only teachers but the school's students, the school as a learning organisation and the broader education community.

Table 1 provides an overview of observations made by the ASMS's teachers, students, leaders and professional partners noting the influence of teachers' learning on the outcomes for other stakeholders. Interpretations of affordances that have supported these outcomes are also presented in the table. Affordances were of a contextual, organisational and relational nature but with sustained interactions between the different affordances.

These interactions capture the challenges of trying to isolate specific factors that make a difference to the quality and outcomes of teachers' learning (as often noted in models of change, see Guskey, 2000; Desimone, 2009). Rather they highlight it is the richness of the school's vision and its enactment as a learning organisation that generated rich and varied learning outcomes for many beyond the teachers.

The research determined that teachers brought existing beliefs and practices to the ASMS but through incidental and intentional learning these beliefs and practices were expanded and often changed. The design of the school created a learning environment in which affordances for learning were rich and varied.

The opportunity for teachers to learn from both intentional processes and incidental opportunities contributed to teachers' knowledge of effective pedagogy including learning and learning processes, new science and mathematics content, effective curriculum design and authentic assessment processes.

They were open to challenges and recognised their roles as learners in achieving the vision of the school. There were varied outcomes for different teachers and this appeared to be generated by the different levels of alignment between individual

139

Table 1. Learning outcomes as reported by ASMS stakeholders – Conclusion

Source	Quote	Affordances
Teacher	*Being on display, to other ASMS teachers and the stream of visitors … I have had more professional interaction with science teachers; something I did little of in my previous school. I have had to spend an immense amount of time planning teaching sessions, more time developing resources online and taking more risks in curriculum delivery. The assessment of tasks has changed through the greater use of rubrics. Teaching science content and concepts has been a huge change.*	Physical proximity Colleagues Explicit PL strategy
Teacher	*The most significant learning has occurred in a triumvirate manner firstly, that based upon the collegial atmosphere of the school, the ability to learn from colleagues both in a semi-formal and informal manner; secondly, the committed stance made by the leadership of the school towards professional development and the third aspect being as a graduate teacher the ability to plan, programme, teach and evaluate. I feel that I have become both a more knowledgeable and effective teacher and this has been supported by everything that happens in this school.*	Physical proximity Colleagues Leadership School vision & culture Sense of personal agency
Teacher	*The close collaboration across the disciplines has meant less skepticism about team teaching.*	Colleagues Interdisciplinary curriculum writing teams
Teacher	*Perhaps it is just repetition, but collegial support, the feeling of being part of a dynamic developing place that gives me the opportunity to try new things and values my efforts has been significant to my learning.*	Colleagues School vision & culture
Student	*… they're like a colleague; you can talk to them about stuff. It's not like 'them' and 'us' … the environment is more relaxed.*	School vision Physical proximity
Student	*At my old school I had some really bad teachers who I just didn't want to learn from, like, I wasn't interested in what they had to say. But here, like, you notice that a lot of the teachers have stuff that is worthwhile to teach*	Explicit PL strategy Interdisciplinary curriculum writing teams
Leadership	*A great positive about leading in this place is people's level of commitment; a real obvious example is that teachers are hardly ever away … it's the lowest level of teacher absenteeism I have experienced in any school …*	School vision and culture Distributed leadership

Table 1. (Continued)

Source	Quote	Affordances
Leadership	*There are so many tangible things, like teachers leading innovation in curriculum but they are easy to see. It's the deeper levels that are harder to capture. I think we have made significant contributions to policy level discussion and our staff's involvement in that at a systems level has been critical. How do you actually quantify that we've had a significant effect on system level policy but we have certainly developed a capacity amongst teachers in our school for them to engage in conversations about learning and about learning environments that need to be created to support raising opportunity, increasing participation and engagement.*	School vision and culture Interdisciplinary curriculum writing teams Physical proximity

teachers and the learning environment as described in Figure 2. Recognition of these variations in an important consideration for school leaders as it provides evidence that both individual teacher characteristics and sense of personal agency together with the learning environment in which they work/teach influence learning outcomes.

The learning environment will be experienced in different ways and the task is to create a rich and diverse learning environment that provides multiple opportunities and processes for learning. This concept can also be translated to learning for students as was the case at the ASMS.

As reported earlier, the students saw no boundaries to their learning and recognised learning as a partnership between themselves and the cultural and physical environment. The cultural and physical environment generated at the ASMS led one teacher to comment:

I have made an escape from a raft of traditional paradigms about schooling as a process. I have been liberated from the school:classroom:teacher: class:subject: grades:reports constructs. I don't see schooling anymore defined by these confining delineations.

Although the ASMS is a unique school, there is much to be learned from those willing to redefine traditional paradigms of schooling and it would be wise not to dismiss the outcomes of this research due to the unique nature of the school. One particular outcome clearly worthy of consideration by those interested in 're-envisioning' not just science and mathematics education but all schooling was the role of the learning space.

The ASMS learning space was reflective of Greenman's (1988) view:

An environment is a living, changing system. More than physical space, it includes the way time is structured and the roles we are expected to play.

> It conditions how we feel, think and behave; and it dramatically affects the quality of our lives. The environment either works for us or against us as we conduct our lives. (p. 5)

The ASMS was an environment that 'worked' for many teachers, students and other educators and although it represented a large economic and human resources investment the outcomes proved insightful and important in understanding what is possible for schooling in the senior secondary years.

The following comment from one visitor to the school in April 2009, seven years on from its opening might be valuable advice on using the outcomes of the research too;

> This school brings real meaning to, 'if we want to shape the future, we must create it'.

NOTES

1 Desimone uses the term professional development in her paper but for the purposes of this paper I have replaced this with professional learning as it more effectively captures the learning culture at the centre of this chapter.

2 An affordance is generated when environmental conditions enable the actors using the environment to achieve a desired goal.

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WESLEY IMMS

7. OCCUPYING CURRICULUM AS SPACE

INTRODUCTION

Learning environment research is gaining previously unachieved sophistication as it develops beyond 'post occupancy evaluation' towards socio-cultural examinations of how students and teachers occupy and utilise space. This chapter argues that knowledge gained though previous research can be 'mined' for such spatial implications. The overlap between gender studies and curriculum is one such field.

Curriculum remains an effective tool for implementing macro-policies of government and articulating wider socio-cultural agendas in schools. However, for all this success there exists a very limited understanding of its lived impact on the student – that is, how curriculum is actually inhabited by an individual. A doctoral study was conducted in the late 1990s to address this paucity of knowledge. When published, the study advanced thinking on this topic, but now is open to further examination. The purpose of this chapter is not to repeat what was found, rather to re-interpret its findings *through a spatial lens*.

Time is a great teacher; academic activity by the PhDs author in the intervening eleven years, particularly in the area of learning environments research, has allowed a different perspective on how curriculum is actually occupied and manipulated by its inhabitants.

A BRIEF RE-VISIT OF THE PHENOMENON OF MALE GENDER
CONSTRUCTION IN SCHOOLS

As a teacher in the mid 1990s I became disillusioned with how school structures allowed so little opportunity for intellectual exploration of issues I encountered each day in the classroom. Excessive teaching demands, time-heavy extra-curricular duties, and a pervading sense of 'practice dominates theory' lead me to resign my role as head of a department to undertake graduate research in another country. Ironically, this created another frustration. My research originally intended to address architecture's absence in the secondary art curriculum.

However, this was diverted during the early coursework components of my study. During those weeks, prescribed readings in compulsory classes such as 'gender issues in education' consistently gave descriptions of boys' experiences in schools that clashed with my own sense of reality. It was an issue I found hard to ignore, and lead to quantitative (factorial ANOVA) and qualitative (ethnographic) studies that

addressed in a small way this rather significant gap in the literature. Inadvertently, it also opened the door to, a decade later, fresh insights into learning environments research.

At that time gender studies in education had not progressed far beyond naively transposing feminist critiques of gender from society directly into schools. The unfortunate supposition was that what happened in society logically also applied in schools. This meant that in the late 1990s knowledge about boys' gender identities was primarily the product of psychoanalytical study (Terman & Miles, 1936), rooted in sex-role theory (Bem, 1974), which had created monolithic and categorical gender definitions (Skelton, 1997). Thus, the literature treated boys as a homogeneous group that enacted a singular, hetero-normative, hegemonic masculine gender identity in classrooms (Skelton, 1996). In short, during the late 1990s virtually all education research on this topic assumed young males to be misogynists in the making (Connell, 1995; Mac an Ghaill, 1996; Reay, 1990).

This body of research conspicuously failed to account for the reality of boys' relationship experiences in schools (Jackson & Salisbury, 1996) and the myriad of masculinities being enacted there (Imms, 2000). Connell (1996), whose work epitomized the accusation of male collective guilt mentioned previously, inadvertently provided the theoretical structure for a deeper understanding of male gender construction in education. By arguing that a range of masculinities existed where the hegemonic dominated the marginalized, Connell opened the door to the argument manliness was owned by the individual male. If so, it was actively constructed through development of personal values and beliefs, not through some ill-defined social conspiracy. Schools and curriculum, it could be argued, assisted boys to build positive individual gender identities.

Research was required that examined the scope and nature of the *multiplicity* of masculinities that existed within boys' cultures in schools, and the nature of curriculum that facilitated their acceptance in those cultures. This was the predominant aim of my research at that time, attempting to isolate qualities of curriculum that allowed boys to explore functional egalitarian masculinities within the schooling system (Imms, 2003). Unrealized at the time, the research also uncovered a spatial element to this phenomenon. The curricular and socio-cultural factors that impacted the creation and occupation of multiple masculinities in schools required a spatial home in which to operate. It is such an added dimension that I wish to explore further in this chapter.

The Study

From 1997 to 2000 I undertook an ethnographic study of year 7–12 boys on this topic. This included a full academic year of fieldwork in a single-sex school in Canada using a participant-as-observer design (Hamersley & Atkinson, 1995). The research utilized a Connellian multiple masculinities theoretical lens as its analytical framework. Visual Art curriculum was its unit of measurement, prior evidence

indicating it provided the wide range of curricular, pedagogical and transactional approaches to curriculum necessary to elicit the data required.

Data collection included hundreds of classroom and general school environment observations, around fifty layered interviews with boys, school administrators and teachers (that is, initial interviews with one, two or even three follow-up interviews), and documentary analysis. Data was analysed using Atlas.ti software following the now standard qualitative analysis techniques of coding, thematic identification, triangulation, model building and theory linkage (leCompte & Priessle, 1993). These data provided a rich, layered, and sophisticated account of boys' perceptions of their experiences in this educational space.

Results

The purpose of this chapter is not to reiterate what is already well documented (Imms, 2000, 2001, 2003a, 2003b) but to leverage from that study some previously unexamined spatial aspects. A brief summary of findings is needed to place that discussion in context.

Participants' responses created a four-layered model of boys' engagement of masculinity, provided in Figure 1. They allowed the research to describe and analyse a complex hierarchy of forms of such engagement that ranged from a superficial level comprising a predictable picture of stereotypes, to an almost inaccessible layer of "individual" masculinities. This final layer, described by boys as separate from their culture and constructed of their personal values and beliefs, owned egalitarian characteristics similar to those being sought by contemporary gender research.
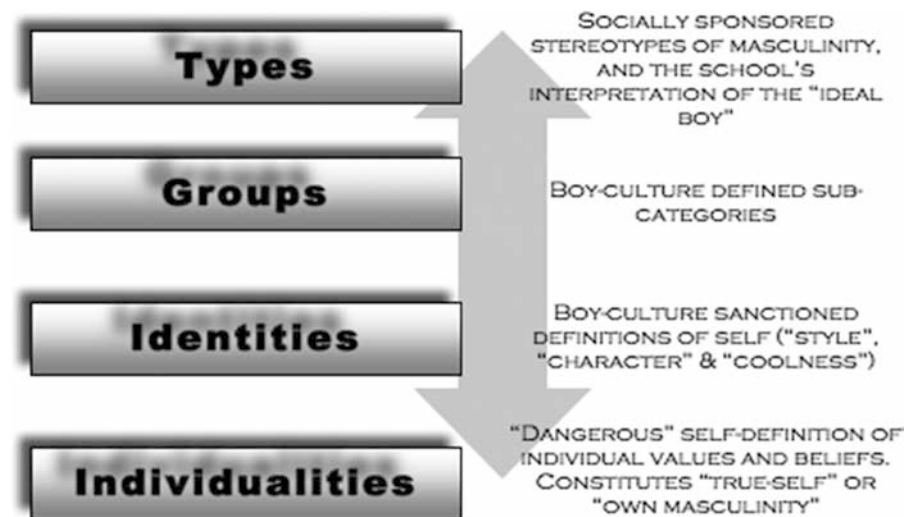
Figure 1. Boys' layered engagement with masculinity

147

Six barriers that limited boys' access to this final layer were identified in the school. They included the dominance of cultural stereotypes, a lack of a safe forum for the exploration of gender identities and an emphasis on a school curriculum that failed to facilitate expression. Additional barriers were related to the lack of freedom within classrooms, curriculum that generally came short of accommodating boys' unique ways of learning, and very limited opportunities to develop egalitarian relationships. Five of these six characteristics combined to create a model of 'boy-friendly' curriculum, illustrated in Figure 2, which boys claimed allowed them to freely explore a range of masculinities.

BOYS NEED CURRICULUM THAT PROVIDES

• A non-competitive school environment
• "Safe" classes that foster discussion
• Tasks that are open-ended and require interchange with others
• Subjects that mandate exploration of "the self"
• Teachers who "facilitate"
• Subjects that accept alternative truths

BOYS NEED CURRICULUM THAT PROVIDES

• Small class size
• Pedagogy that counters katagelophobia
• Skills to enable expression
• A vocabulary to discuss masculinity
• A mandate to explore individuality
• Opportunity to engage "a passion"
• Opportunity to be a risk-taker
• A level playing field between types of masculinities

BOYS NEED CURRICULUM THAT PROVIDES

• A wide variation of courses and activities
• Teachers with "passion"
• "Disciplined freedom"
• Avenues to be impetuous
• A school atmosphere that encourages participation
• Tasks that are "relevant" - can be explored through boys' culture
• Problem-based learning, ("doing it")
• Hands-on activities with practical solutions

BOYS NEED CURRICULUM THAT PROVIDES

• Teachers skilled at facilitating boys' exchange of ideas
• A range of Tools to express ideas
• A range of outcomes to set tasks
• Criticism skills
• A mandate for the expression and an exchange of ideas
• Subjects with "non-binary" epistemologies
• Subjects that are Non-competitive and allow access to boys' culture

BOYS NEED CURRICULUM THAT PROVIDES

• Freedom for individual interpretation of curriculum tasks
• Freedom to undertake curricular tasks according to personal skills
• Freedom to move between groups
• Freedom to access a range of academic and non-academic activities
• Freedom from pursuing any "ideal" masculinity

Figure 2. Model of 'boy-friendly' curriculum

These findings held considerable significance for masculinity research. They indicated that many boys already owned the impetus to explore egalitarian masculinities. However, boys required 'space and place' in which to conduct this exploration. The study found that mobility between the types of masculinities existing in this school, represented in Figure 1 by the vertical arrow, was regulated by transitory socio-cultural factors, characteristic of and embedded within the mores surrounding boy behaviours.

The study identified that in this culture, where stereotyped definitions ruled, to be mobile towards more egalitarian layers of masculinity boys intentionally used particular subject curricular, summarised in Figure 2. This chapter will argue that the physicality of the school setting was an important additional aid to boys' negotiation

of multiple masculinities. In other words, gender negotiations were frequently site specific. A review of the data indicates that physical affordances of space were notable agents in boys' negotiation of masculinities.

EVALUATING CURRICULUM FROM A SPATIAL PERSPECTIVE

Engaging Curriculum Spatially

Located in these results and at times explicitly stated was the school's built environment. Boys consistently identified spaces that facilitated certain encounters – activities that were later analysed to constitute negotiation of masculine concepts. Boys' own comments indicated that 'preferred' classrooms were those that allowed freedom of movement, informal groupings, conversations while working, and ready access to materials and learning resources.

These spaces did not, through spatial organisation, treat students as a homogeneous mass but provided a spatial environment where different 'types' of boys were allowed equal access to each other. Summarised in the project's findings, one of the five characteristics of boy-friendly curriculum was 'curriculum that provided boys freedom' (see Figure 2). This contained three subsets, academic freedom, intellectual freedom, and physical freedom. The latter remains largely under-researched, and requires further 'teasing from the data' of this study.

Student Use of Physical Space in Gender Negotiations

Eleven years after publication, a review of the study suggests it contained an overly simplistic treatment of space. In the late 1990s classrooms were simply that – classrooms. With only a few exceptions (as discussed by O'Donoghue, 2006) there was little research that included spatial factors within critical-social analyses of education. This study mirrored that trend. It mentioned, but left unresolved, space as constituting a physical site for gender negotiations. However, on review, the data clearly shows the socio-cultural/curricular/spatial aspects of boys' masculinity negotiations frequently overlapped.

Spaces *afforded* certain practices, which in turn afforded certain interactions. In visual art, studios provided spaces within which boys gravitated to specialist activities. For example, the ceramics room facilitated hand-building and wheelwork. Existing in the same studio these activities appeared to be simply variations of a similar medium, but not to the boys. Boys claimed they chose these activities based on the 'types' of colleagues who occupied the spaces, and the qualities of the activities they undertook there; *"I am a wheel kid – we think differently to the sculpture boys…"*. This gravitation to particular spaces allowed construction of informal 'safe' places to explore relationships, inadvertently building gender constructs; *"You can't talk like this anywhere else – other places are too public, or too restricted, not our own spaces. We own these spaces…"*

149

Spaces *excluded* certain practices. Learning spaces directly controlled learning activities. For example, visual art's studios were seen to facilitate open, collaborative and experimental study; *"In here, we can do what we want, with who we want, how we want. Can't do that in other places."* This was in direct contrast to the closed and insular classroom layout typical of much of the school; "*Those classrooms, you can't be part of a group. Teachers just teach to you. It sucks."* This lead to particular learning styles being privileged in particular spaces.

Boys identified learning environments as dictating certain learning styles, certain knowledge, thus certain level or types of engagement with learning, as well as with each other; "*In the academic subjects* [always held in didactically structured classrooms] *you just read from the book, you pass back that information. There is no you in that work, it's all about the stuff in the book."*

Spaces *elicited* certain practices. Embedded in study data was evidence that boys actively engaged curriculum in a physical/intellectual sense, in tandem. They chose particular places to sit, rooms to meet, and locations to do particular work, which was all part of the 'grouping' activity described in Figure 1.

Classrooms, hallways, cafeterias, common rooms and outdoor meeting areas were physical venues that were consciously sought to help facilitate unique gender practices; *"We come here to, y'know, just talk and swap stuff. We can't do this other places, this is our place. The other kids don't understand what we do, so this is where we can have our own spot…"*.

These spaces regulated behaviours that were both restrictive (reinforcing limiting gender stereotypes) but were also empowering – facilitating explorations of gender constructs not elsewhere allowed (O'Donoghue, 2006). Within this school's 'boy-culture' particular places constituted territories of learning and territories of gender negotiation. Thus learning environments were defined by the practicalities of curriculum demands, but also by social needs, adding a complexity of meaning to what is often considered an inert educational asset – space.

CURRICULUM AS AN OCCUPIED SPACE

A review of the data from this study highlights that curriculum may be better understood through examination of how it is actually used. The 'reality' of curriculum lies not in its structure, but in its occupation.

The processes of 'occupation' is constituted of students' actual actions as they engage within formal and informal curriculum. The original study described one aspect of this, illustrated in Figure 1, being boys' mobility between layers of enacted masculinities, dependent on social situations and settings. On the surface boys were situated within a mono-culture constructed and enacted by the school's structures and operation. But in actual practice, as curriculum was 'lived', this quickly disseminated into smaller, layered groupings. These were contested and always in a state of being negotiated between ephemeral cultural groupings, changing as boys consistently re-defined the values and practices inherent within each.

150

Revisiting these data through a spatial, architectural lens provides additional focus to the nature of this occupation. Occupation can be viewed as seeking identity, the *habitus*. We are inescapably linked to the places we inhabit, and this occupation, in part, defines us. We identify as habitué of the places we occupy (de Botton, 2007). Occupation can be viewed as seeking safety, the *sanctum*. While being in a space is a 'real' experience, we go beyond to the illusion of what we wish for, to those heterotopia where we simultaneously live the real and through desire experience the illusionary (Foucault, 1984).

Occupation can be seen as *genus loci*, seeking the special or the unique. Space can provide a 'special place' that is greater than the sum of its parts, a poem rather than structure (Bachelard, 1958/1994). As such we do more than simply dwell within the structure, we physically and cognitively *engage* with it.

Original analysis of these data identified boys' inner beliefs and values being the motivation for negotiating certain types of masculinities. But what it did not do in enough depth was to explore the lived experience within that process. Re-reading these interviews through a spatial lens illustrates boys seeking to occupy a special place within curriculum's structure. And while cerebral, this occupation is also physical. In boys' comments there was a realization that they were habitué of built spaces within the school, but this physicality was in alignment with the intellectual structure of the school curriculum.

Within this duality they desired to access a sanctuary, a place of safety where their deeply situated concepts of fairness, equity and personal expression could be used to freely explore a range of gendered identities. They regarded this sanctuary as a type of heterotopia, a virtual space where personal values and beliefs could exist within a perceived dominant hegemonic school culture.

What Architecture Can Teach Education

This chapter began with a lament; education excels at conceptualising and designing curriculum, but arguably it understands little about how people occupy it as a living structure. This is apparent when reviewing trends in curriculum theory development over the past century.

The three dominant approaches are evident. One has viewed curriculum as a method to transmit facts, skills and social values to students. In the 1920s Thorndike viewed intelligence and behaviour as innate, and students as passive beings who responded to stimuli; thus learning was a physiological mechanism. About the same time Bobbitt argued that education existed to prepare students for everyday life, thus needed to train them in activities that provided a 'well-rounded' existence. In a similar vein, during the 1960s Skinner saw behaviour as being controlled through conditioning.

Schools, he argued, existed to shape and maintain certain socially acceptable behaviours. Collectively, this approach to curriculum viewed schools as a factory, the child as its product, the teacher as the worker and curriculum as its

management system. From this theory it evolved a competency-based curriculum organised through specific subject disciplines as linear 'pathways of knowledge'. Curriculum was, from this perspective, an agent for constructing an acceptable society.

Curriculum has also been approached as being a process of dialogue, within which teachers and students reconstruct knowledge to affect personal meaning. In the early twentieth century Dewey advocated designs that reflected social democratic principles of negotiation and interaction. Curriculum, he believed, transmitted culture but within dynamic democratic methods. To a large degree this was based on the work of Pestalozzi in the 1820s, which viewed curriculum as a process of understanding the needs of the child and their attempts to analyse and make inferences from experience. This transactional approach to curriculum recognised learning as the organisation of internal structures that occur as a child interacts with his or her environment.

A third epistemology was that of the transformational curriculum, an approach that effected social and spiritual change in an individual. During the 1910s Rousseau argued that children in their natural state were inherently good and only became corrupted through contact with society. Thus, within this framework curriculum was required to engage the student in seeking harmony between himself of herself, and his or her spiritual environment. Neill's *Summerhill* in the 1960s extended this belief to claim the school must fit the child, not the reverse.

It must renounce traditional mantras of discipline, pre-programmed learning 'directions', and moral and religious training. The open education movement in the 1960s went further to lead development of open plan schools that argued each child was a self-activated maker of meaning and an active agent in her or his own intellectual development.

These transmissional, transactional and transformational genres of curriculum remain largely aspirational. Without commensurate attention to the physicality of their implementation, how they are actually lived or inhabited by students, they fail to deliver full understanding of curriculum's defined purpose, that of it being *a journey* or lived experience, as opposed to the less accurate and quite simplistic notion of curriculum being a set of prescribed learning tasks.

That is not to say such critical analysis has not been undertaken. Pinar et al. (1996)'s massive anthology of post-1960s curriculum theory summarises hundreds of scholars who argue curriculum has little to do with planning learning; its effect is to marginalize and control. They say schools, like society, are corrupt and rife with injustice and oppression.

They are not politically neutral, curriculum is an agent of these forces, and curriculum's 'reality' can only be understood by being viewed contextually through the lenses of the racial, gendered, religious and institutionalized political agendas that drive society. Berlak and Berlak (1981) similarly critique teaching practices, arguing the existence of a range of 'dilemmas' that confront teachers as they attempt to situate actual classroom practice within the stated goals of formalized curriculum.

152

Critical analyses of education are rife with such attempts to explain the reality of teaching and learning, of the hidden as well as the formal curriculum. However, they fail to come to grips with the complexities of what students actually do. While many researchers, particularly those from a phenomenological orientation, have closely studied students in their educational settings (van Manen, 1988), few have attempted to understand how their day-to-day activities constitute the act of negotiating a lived experience within the curriculum. This may explain why the impact of space on student experience has received so little attention in education.

What lesson is to be learned from this study? In brief, it would be that curriculum isn't all it is cracked up to be. Education can't expect too much from what is ultimately only a piece of writing. Students have little regard for such documentation; they pick and chose elements of curriculum to use according to needs only sometimes associated with educational goals and curricular outcomes. Those who design curriculum entertain presumptions about how it will impact student outcomes, but this rarely occurs; the reality of curriculum is not what is written, but what is done.

Here there is an informative parallel with architecture. Designers intend for a structure to be used in ways that may bear no resemblance to how people actually occupy those spaces. An example would be in Australia's Building the Education Revolution schools. This significant publically funded initiative produced innovative learning spaces across a whole country in a very short period of time. Many wonderful structures were created. They embodied a hope that their design, driven by current educational thinking on best practices, would revolutionize teaching in Australia. They were light and spacious, oozing technology, with collaborative spaces and new-age furniture. Their design accommodated multiple learning styles for students with multiple needs. The question is, have they facilitated the pedagogical changes obviously embedded in their design? Only limited evidence of any impact on teaching and learning exists, partly due to few good measurement instruments. But what is known mostly indicates intransience. Many teachers have resisted changing from established practices in these new spaces; they exhibit poor 'environmental competence' (Lackney, 2008), arguably driven by no mindset for change (Hattie, 2008).

While these structures are innovative, teaching within appears to mostly stay the same. The designers of the structure can't dictate the activities of those who inhabit it. Buildings, of themselves, are not a catalyst for change. The same can be said for curriculum. Like a building, it is just a structure to be inhabited. If it is badly designed and inappropriate to local needs, out of touch with its occupant's interests, it will stand largely underutilised.

A review of this doctoral study emphasizes that – like dwellers in a building, students occupy curriculum – they become habitué of that space. They ignore aspirations of the architect (or curriculum writer) as to how it is supposed to be occupied. Students adapt the space according to their own needs, to create a sanctum to fit their own purposes. They go beyond engaging with curriculum, to occupying it like a structure, modifying and personalizing it knowing that while they must

153

meet some curricular targets they can simultaneously build and occupy another reality within that structure – a heterotopia. Like the boys in this study, they turn the established, built curriculum into genus loci, the special places of their own that meets sophisticated cultural needs well beyond the designed intentions of the structure.

CONCLUSIONS

What does this teach us? Buildings can be impressive, but are just mechanisms for allowing teachers and students to do their work. Likewise, curriculum is just a mechanism, a framework, a document. It can't work for us – teachers must embrace it, modify it through program development to suit their particular student needs. It is within the complex and multifarious ways that teachers and students *inhabit* curriculum that lie the qualities that actually makes it 'work'.

This re-visit of a curriculum and gender-focused PhD thesis highlights that we can gain considerable insight into the lived experience of those who inhabit modern learning environments by exploring the previously hidden aspects of students occupying school spaces. In this context the word 'sophistication' was mentioned in the opening section, not to make any claim about this particular study, but to emphasise that one of the emerging discourses in learning environments research must be the socio-cultural. While we should continue to evaluate new school designs in terms of building performance, the curricular flexibility they allow, and (in rare cases) their impact on learning environments, exploring in greater detail their psychological aspects will only improve our holistic appreciation of the wonderful phenomenon of school space.

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PART 3

**EVALUATING LEARNING PLACE/SPACE DESIGN
AND IMPLICATIONS FOR FUTURE DESIGN**

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8. PLANS AND PEDAGOGIES

School Design as Socio-Spatial Assemblage

INTRODUCTION

The concepts in this chapter were originally presented in the Journal of Architecture in 2013, addressing a design oriented audience. The research findings are included in this book to ensure an educational audience has the opportunity to see the links between pedagogy and space which were encountered in this study. The design of learning environments at every level from primary to tertiary is undergoing major transformations involving the proliferation of new learning spaces that are variously termed learning 'streets' or 'commons', 'meeting' spaces and 'outdoor learning' areas together with complex new interrelations and overlaps between them.[1] Such changes are largely driven by long standing changes in pedagogical theory and practice that may be broadly described as a recognition of both formal and informal learning and a move from teacher-centred to student-centred learning.

The traditional classroom is a product of a teacher-centred pedagogy, framing a hierarchic relation between teacher and students while closing out other activities and distractions. It is also a form of what Foucault (1979, 1980) terms a disciplinary technology where the gaze of authority works to produce a normalized and disciplined subject. It has long been clear that student-centred pedagogies are seriously constrained by traditional classrooms. What is not so clear is how new forms of open school environment*s* are matched to the new pedagogies. The primary goal of this paper is to critically analyse a range of recent celebrated middle-school plans within such a theoretical and pedagogical framework.

This transformation in school design has a century long history that we cannot recount in detail here. The 19th century school was based on a monitorial model with large groups being taught by one teacher at the front supported by a number of monitors who drilled smaller groups on the material set by the lead teacher (Burke & Grosvenor, 2008). By the late 19th century this large space became segmented into what remains the standard classroom type with classes of 25–30 students (Markus, 1993; Burke & Grosvenor, 2008).

From the early 20th century Dewey (1966 [1916]) argued for a more student-centred model of learning highlighting the importance of social context, student interaction and play. A range of architectural innovation commenced as some schools became more connected to the outdoors and 'hands on' learning spaces

such as laboratories, studios, workshops and gymnasia were incorporated. The trend towards 'open air schools' developed through the educational ideas of Steiner and Montessori and was especially strong for early childhood.

Following the Second World War the modernist movement in architecture was deployed in a rapid increase in school construction programs for expanding student numbers—the mass-production of traditional classrooms most of which still operate today. However, there were also responses to changing pedagogies with considerable architectural innovation particularly through the work of Scharoun (Blundell-Jones, 1995), van Eyck and Hertzberger (2008). In the 1970s the so called 'open plan' school began to proliferate in the developed world, a move that was largely abandoned by the 1980s when many such open plans became segmented into traditional classroom cells.

While there were many reasons for this failure it is clear that the open plans often confused flexibility with openness and were poorly matched to new learning practices. In the new century we are seeing a substantial re-emergence of student-centred pedagogy in all educational sectors, geared now to communications technologies and information flows that are difficult to achieve in the traditional classroom. A new round of architectural innovation has emerged globally with the specific goal to better enable such pedagogies.

Instead of simply 'open' plans we are seeing assemblages of different spaces grouped in clusters with meeting rooms, learning commons and traditional classrooms in a myriad of new arrangements. Our key research question here is focused on this emergence of new plan types. How does architecture respond to changing pedagogy and how are underlying issues of power, control and discipline played out? Questions about the success of such pedagogies or plan types in terms of learning outcomes is important research but lies beyond the scope of this paper.

A typological framework is proposed for analysing both pedagogical practices and the typical plans that have emerged to accommodate them. We suggest a model for understanding the connections between architecture and pedagogy and apply it to the analysis of a sample of middle-school plans recognized as innovative in responding to new pedagogies. To contain the complexity we have focused on middle-schools and on the primary teaching 'clusters' within those schools.

The middle-school, incorporating ages of about 12–15 years, is recognized as a time when students are undergoing significant transformative experiences—moving into adolescence with related puberty issues, moving from primary school to secondary, and taking increased responsibility for their learning. There is much at stake in this age-group, as Eccles et al. (1993: 94) argue: "It is at this stage that many children who were doing well at and enjoying school begin to lose interest and develop patterns of behaviour inimical to successful school completion". Middle-schools paradoxically emerge as places where students may need supervision and control but also where there is great potential for new pedagogies to open pathways of student-centred learning.

CONSTRUCTIVIST PEDAGOGIES

The evolution of pedagogical theory that drives this transformation can be simplistically framed as three stages: behaviourist, cognitivist, and constructivist. Behaviourist approaches are based on the stimulus-response psychology of Pavlov and Skinner linked to a didactic teacher-centred pedagogy and a 'bells and cells' model of school planning and design where time and space are clearly segmented. Cognitivist approaches emerged through the works of psychologists such as Bruner (1966) and Piaget (1972) who argued for an approach directed at moving from low order to higher order thinking through a hierarchy of activities – remembering, understanding, applying, analysing, evaluating and synthesising – each associated with a range of learning spaces.

Constructivism emerged in the 1970s, largely based on the much earlier work of Vygotsky (and Dewey) who argued that remembering and application of knowledge had to be situated in the student's lived world in order to become authentic learning. In other words, students 'construct' their own meanings and they do so in a social context (Vygotsky, 1978). In this view learning is first interpersonal or social, and only then becomes embodied—the higher functions of learning originate as social relationships (Vygotsky, 1978: 57).

The learning environment is a zone – at once social, spatial and informational – within which existing skills and knowledge can be connected with those that might be learned next. This has been extended to the concept of the school environment as 'scaffolding'—a temporary framework that enables the social construction of knowledge to take place and then be removed as students become autonomous learners (Wood, Bruner, & Ross, 1976). It is central to constructivist learning theory that genuine understanding is related to the extent to which the student can interact with both adults and peers in a flexible and open-ended manner.

While many of the experiments with open planning from the 1970s were perceived to fail, constructivist pedagogies have since been increasingly adopted by educational institutions and ministries globally, generally under the rubric of 'student-centred learning'. The demand for a more *pedagogically* supportive school architecture has led to the emergence of organisations (in the English speaking world) such as the *Council for Educational Facility Planners International* (CEFPI), *Design Share: Designing for the Future of Learning*, and the *British Council for School Environments* (BCSE) devoted to this transformation. It is from these organizations we draw our sample of plans.

In order to analyse the relationships to spatial form and structure, we have developed a 6-part typology of teaching/learning *practices* based on constructivist *pedagogies*. This typology involves the categorisation of fluid phenomena where distinctions are often blurred; yet it is based in a rigorous understanding of the *pedagogical* theory and can be linked to a number of such typologies that have been developed in the literature (Fisher, 2007). The typology is summarised in Table 1 and is based on a loose continuum of group size from presentation of information

to large groups, through four kinds of interactive activity in three group sizes, to the reflective activities of the single student. These are not separate types so much as a simplified framework for understanding and analysis.

In each case we have assigned an indicative percentage of school time that might be spent in each of these learning modes within a constructivist pedagogy. This involves a set of presumptions that can be contested; in an everyday situation these different pedagogical practices morph rapidly and frequently into each other as groups form and break up with different tasks over the day. The listing of the typology in this form is not intended as reductionist or mechanical—these categories are simply tools for analysis. In the constructivist model these types are richly interconnected both in space and over time as groups segment and amalgamate, as students and staff move between different activities. Didactic teaching (as presentation) remains part of this mix but is reduced to a small portion of the total time.

Table 1. A typology of student-centred pedagogies

PRESENTATION 25–150 students	Students or teachers present to a largely passive group. Whilst contrary to a strictly constructivist regime, on occasion such meetings are necessary at the start and end of day, in Year or House Groups and on other occasions. These spaces are often 'created' in the learning commons or large foyers. Group size may vary from one class cohort to a full form or year. Such activities facilitate efficient communication of information.
LARGE INTERACTIVE 25–75 students	Activities that move seamlessly from large to small group and back; often organized in sub-groups of 4–6 that can be subdivided again into 2s or 3s. Facilitates peer-to-peer learning and team teaching.
MEDIUM INTERACTIVE 10–25 students	Activities with a similar flow of movement to the above, but with a smaller group size and generally one teacher.
CREATIVE INTERACTIVE 10–25 students	Interactive activities but with an emphasis on hands-on learning in addition to pens and keyboards, plus access to a range of resources that may include art materials, wet areas, laboratory or outdoors.
SMALL INTERACTIVE 2–5 students	This is the 'breakout' model of problem-based and peer-to-peer learning with small autonomous groups that may disperse and take responsibility for their learning.
REFLECTION 1 student	Singular activities that include reading, writing or hands-on research to meet learning objectives.

NEW PLANS & SPATIAL TYPES

We now analyse a sample of 59 notable and award-winning middle-schools drawn from the three organisations listed earlier and that were designed to engage with

pedagogical change. Each of these organisations lists in their assessment criteria design for a range of contemporary pedagogical practices. These specific statements vary for each organisation and the actual criteria statement can be found on the references websites. The largest cohort (41 plans) is the awards program for new school design as published by *Design Share: Designing for the Future of Learning*. This is an organization that showcases: "examples of innovation that remind us why school buildings and campuses exist in the first place: learning!

More importantly, we focus on how we design for the ever-changing future of learning and larger community connections".[2] The second source (10 plans) is from the Australian awards program of the *Council of Educational Facility Planners International* (CEFPI) an organization with an agenda of 'promoting best practices in creative school planning'.[3] A further cohort (8 plans) has been derived from contacts within the *British Council for School Environments*, a more recent organisation devoted to "new thinking about schools and learning environment design".[4]

The total sample has a bias towards the English-speaking world but includes examples from Japan, Singapore, Netherlands, China, India and Norway. This comprises a total database of 59 middle-school plans constructed over the past decade and covering a broad range of attempts to engage with new pedagogies through innovative architecture.

These plans are replete with spatial categories such as 'general learning area', 'learning commons', 'learning street', 'open learning', 'lounge', 'collaborative learning', 'studio', 'meeting', 'activity area' and 'breakout', each of which can mean many things. While such discourse can usefully indicate an intention, our analysis focuses on the form and structure of the architectural shell—including the adaptations that it enables or constrains.

Rather than simply reading these categories off the plans we have analysed the plans to develop a typology[5] of spatial categories. Our focus is limited to the primary learning clusters of each school, excluding those facilities that are shared with the larger school community. The key questions are: how have these spatial clusters been segmented into spatial categories or place types, and how have such categories or types been assembled? We have classified the different spatial types found within the learning clusters into six primary categories as described in Table 2. These spatial types begin with the traditional classroom but are extended to what we are calling the 'commons', 'streetspace', 'meeting', 'fixed function' and 'outdoor learning'.

Such a typology simplifies a complex range of places and any analysis requires a difficult balance between depth and shallowness. A more extensive typology may be more fine-tuned but the capacity to understand the clusters would decline. The six categories are rarely mutually exclusive and often overlap. Meeting areas and fixed functions can be an integral part of commons, streetspace and classrooms or they can be separated. Some spaces can be transformed from one type to another, a key issue to which we will return.

The distinction we propose between 'streetspace' and 'commons' is salient because the existence or absence of through traffic enables and constrains a different range of

Table 2. A typology of learning spaces

Space type	Attributes
Classroom	A traditional closed learning space of about 40–60 sq metres for 20–30 students. If learning spaces are fully 'closeable' to this size with flexible walls then they are classified as classrooms.
Commons	A learning space of greater than about 40 sq metres that cannot be fully closed into a 25 student classrooms (or smaller) and is not the major access route to any other commons or classroom, hence protected from major through traffic.
Streetspace	An open learning space (over about 3 metres width) that cannot be closed into classrooms and is exposed to major through traffic as the primary access space to other learning spaces.
Meeting area	A small learning area of less than 40 square metres accommodating groups of 5 to 20. While such spaces may house seminars, the key criterion is that they cannot house a traditional class size.
Fixed function	Any learning space fitted for specialized use such as 'Arts', 'Science', 'IT', 'Computers', 'Wet Area', 'Music', 'Drama', 'Resources'.
Outdoor learning	Any outdoor area defined on the plan as an integral part of the learning cluster, generally labelled 'outdoor learning' or 'learning court'. Simple access to the outdoors does not qualify.

learning activities with impacts on issues of privacy, group identity and the acoustic environment. We have designated an open learning area as 'streetspace' when it also has a primary function as a thoroughfare. The loss of acoustic control strips the space of significant teaching and learning functions. In addition to this six-part typology we have also mapped two categories of ancillary space: corridors or access spaces too small for learning activities (<2 metres) other than display; and 'staff only' areas.

COMPLEX ADAPTIVE ASSEMBLAGE

We have thus far suggested typologies of 6 pedagogical practices and 6 spatial types. Each learning cluster is a set of spatial parts ('meeting', 'classrooms', 'commons', 'streetspace', 'outdoors' and 'fixed') that enable or constrain different teaching/ learning practices (presentation, interaction, retreat and so on). Before analysing these interconnections we first flag three key issues followed by a short theoretical excursion.

First, any detailed mapping of spatial practices onto spatial types would soon become impossibly complex – the use of these spaces is deeply and essentially unpredictable. Second, the degree to which each space can adapt to different practices becomes crucial; the learning 'commons' and the 'outdoors' are the only spatial types that easily accommodate all learning practices, while others such as 'meeting', 'streetspace' and 'fixed' spaces are geared to a narrower range. Third, the

structure of interconnections between elements of each cluster – the ways they are assembled – will be crucial mediators of spatial flows from one practice to another. These three characteristics – complexity, adaptability, assemblage – mark these new learning clusters as complex adaptive assemblages.

We want to briefly flag two related theoretical frameworks that have driven the analysis and that draw upon these three key terms: complexity, adaptability and assemblage. The first of these is 'assemblage' theory, as developed particularly by DeLanda (2006) based on the book 'A Thousand Plateaus' by Deleuze and Guattari (1987). The term 'assemblage' here is a translation of the French '*agencement*' which is akin to a 'layout', 'arrangement' or 'alignment' – it suggests at once both dynamic process and a diagrammatic spatiality.

Assemblage is a useful way of re-thinking theories of 'place' in terms of process, identity formation and becoming (Dovey, 2010). An assemblage is a whole that is formed from the interconnectivity and flows between constituent parts—a socio-spatial cluster of interconnections between parts wherein the identities and functions of both parts and wholes emerge from the flows between them. A learning cluster is not a thing or a collection of things, it is the assembled connections between them (at once social and spatial) that are crucial.

Assemblage is at once verb and noun—it is the flows of life, people, materials and ideas that give the learning cluster its emergent potential. The dynamism of assemblage involves the ways territories and boundaries are inscribed and erased, the ways identities are formed, expressed and transformed. Territory is a stabilised assemblage, a zone of order, a sense of home that keeps chaos and difference at bay (Deleuze & Guattari, 1987: 310–312). Deterritorialisation is the movement by which territories are eroded as new assemblages are formed. Traditional classrooms are fixed territories while the spaces designed for new pedagogies are relatively deterritorialised.

The increasing levels of complexity, adaptability and self-organization embodied in constructivist pedagogies suggest a second and complementary framework of complex adaptive systems theory which seeks to understand the dynamics of complex systems where the outcome of a system depends on unpredictable interactions between parts. This is work that grows out of a mix of theories of cybernetics, chaos, complexity and resilience, much of it transferred from the study of natural systems (Gunderson & Holling, 2002; Walker & Salt, 2006).

A complex system is one where the parts adapt to each other in relatively unpredictable ways, they self-organise. The detailed outcomes of such a system cannot be determined in advance but rather 'emerge' from practices of adaptation and self-organisation (Johnson, 2001). Such theory in relation to pedagogy and school design has been explored (Davis, 2004; Davis & Sumara, 2006; Upitis, 2004) but we are not aware of the kind of mapping we propose. Some key properties of complex adaptive systems include the diversity and redundancy of different parts such that each performs a multiplicity of functions where no single part is crucial to success and the system can adapt by moving forms, functions and flows around. The tendency to maximize efficiency of the system – often the goal of formal planning – can lead

to a loss of redundancy. As with assemblage theory, there is no easy way to define the 'system' as each learning cluster is an interactive part of further systems at higher scales – school, community, local government and state. While such theory is useful for understanding complexity and adaptation the term 'system' carries connotations of predictability and systematic control—the 'complex adaptive assemblage' is a more accurate and useful label for the classroom clusters we have analysed.[6]

MAPPING LEARNING CLUSTERS

Our analysis of the plans involves understanding the degree to which each of the spatial types appears in the sample plans and the forms or patterns of interconnectivity and interpenetration with adjacent spaces. To this end we have developed a method of diagramming each plan according to the presence of the spatial types and the degree of their segmentarity into closed or closeable teaching areas.

Such an approach has two important antecedents in architectural theory. The first is spatial syntax analysis as a means to understand the sociality of spatial structure (Hillier & Hanson, 1984; Hillier, 1996). Such an approach relies largely upon the analysis of separated spatial segments and works best in detecting the socio-spatial genotypes of highly segmented space—such as the ways in which a traditional school reproduces traditional pedagogy. The spatial structure of a series of classrooms entered from a single corridor is identified with the architecture of discipline and with institutions of surveillance and control, linked to their cousins in the prison, asylum, office, hospital and so on (Markus, 1993; Foucault, 1979).

The other clear antecedent is that of Alexander and his colleagues in the development of a 'pattern language' (Alexander et al., 1977). For Alexander a pattern is at once a set of socio-spatial forces and a formal diagram that resolves them. While such design patterns are often seen as formulaic Alexander's approach involves a multiplicity of fluid patterns and has a good deal in common with assemblage theory (Dovey, 2010).

To analyse the emerging plans we have developed a method of mapping that represents the range of spatial types together with segmentarity, interpenetration, connectivity and adaptability. Figure 1 (note that the colours can only be seen in the eBook edition) shows the method we have developed to represent spatial types and their interconnections resulting in a cluster diagram for each plan. The six spatial types are colour coded and juxtaposed to show both the degree of openness to surrounding spaces and the potential for flexible connectivity. All spaces that are, or can become, open to adjacent spaces are represented as translucent while closed spaces are opaque. The interpenetration or overlap of connected space types is represented by an overlap of translucent colours. Openable walls are represented by direct adjacency while a connecting doorway is a line.

The diagrams produced from the plans are abstractions or conceptual tools designed to help understand the assemblage of spatial types. While this method seeks to be objective in establishing whether different spaces can or cannot be closed as evident on the plan, the method is intended to reveal rather than eliminate ambiguities.
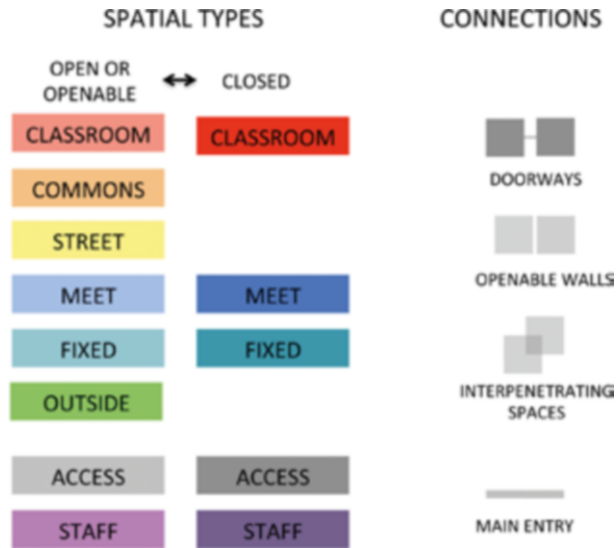
166

Figure 1. Types, connection and diagrams

The sample of plans generates an enormous variety of diagrams and demonstrates that spatial innovation is moving in many directions at once with a great deal of experimentation. However, we suggest that these plans can be categorized within a framework of five cluster types along a loose continuum from the traditional corridor based classroom plan to the fully open plan.

These cluster types are demonstrated in Figures 2–6 which first shows a generic diagram followed by example plans that falls into that category and the specific diagrams derived by mapping them.

While not all plans fit neatly into these five cluster types we suggest this can be a useful framework to analyse the range of spatial experimentation that is taking place in response to changing pedagogies. The first type (Figure 2) includes plans where clusters of traditional closed classrooms are entered from a corridor or access space without direct access to other teaching spaces and without openability between classrooms.

While other spatial types may be provided for the larger school they are not incorporated into the learning cluster. The second type (Figure 3) is identical to the first except that the corridor access to the classrooms is expanded to become streetspace without changing anything else – hence 'classrooms + streetspace'. This is an adaptation that introduces streetspace into the teaching/learning cluster while keeping the classroom cells intact but without any commons or convertibility. Here we find a recognition of the value of a 'breakout' space but the classroom remains a closed cell that one must 'break' from – there can be no easy flow between spaces. Both of these types remain largely traditional in spatial structure. Since the sample

167
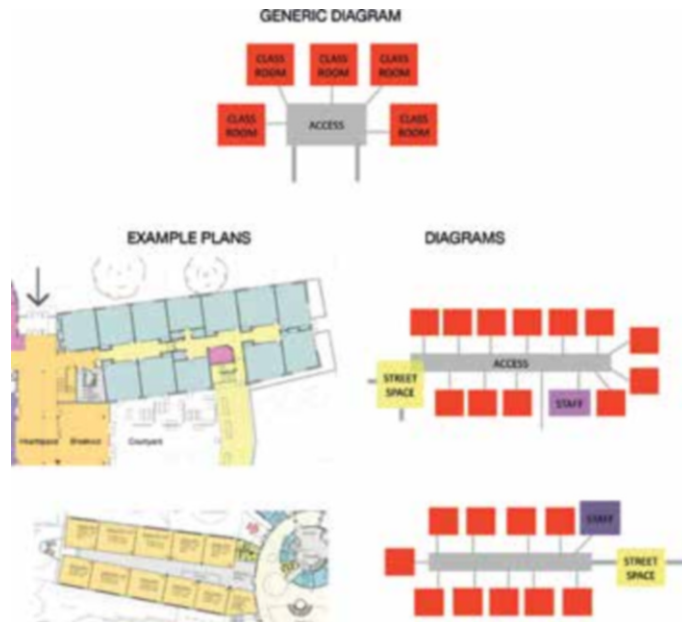
Figure 2. Traditional classroom clusters
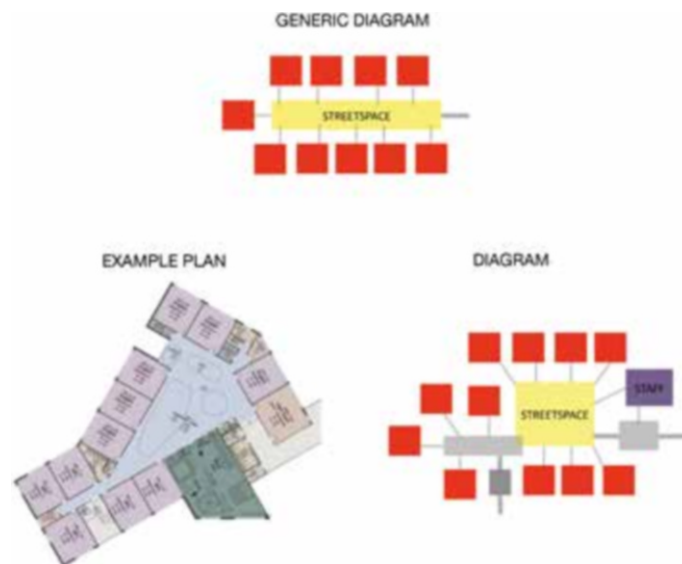
Figure 3. Traditional classrooms + streetspace
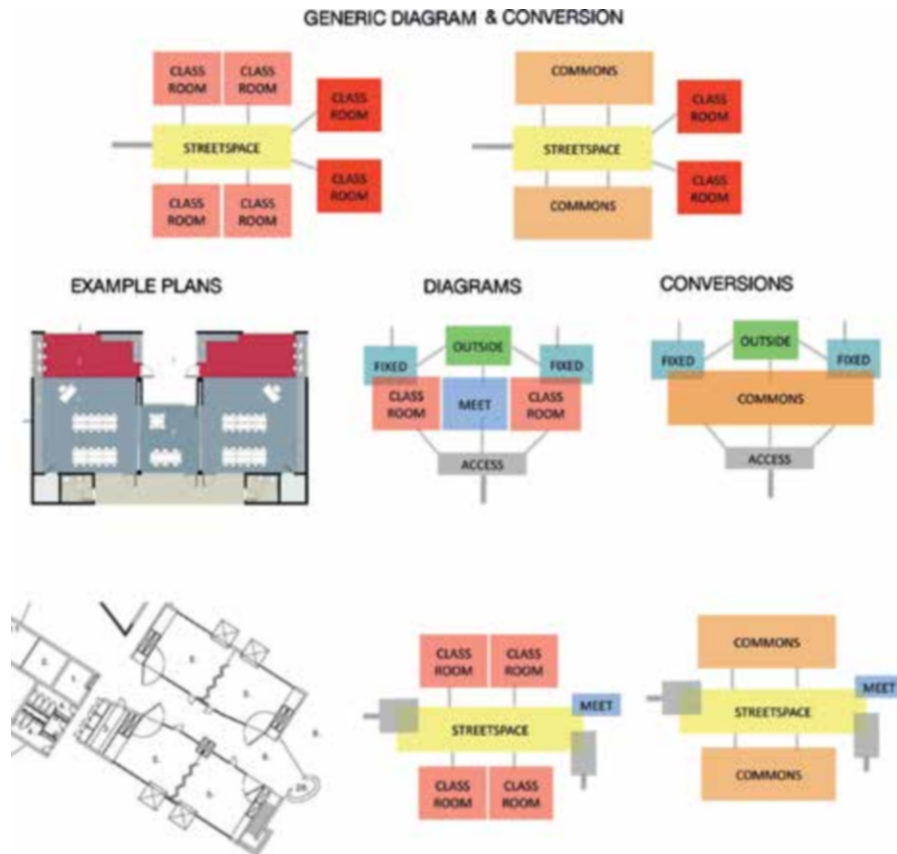
Figure 4. Convertible classrooms

of plans was chosen from those showcased by organisations promoting pedagogical change it is surprising to find that almost half of the sample (44%) are of these types. In these plans architectural innovation often occurs at the level of the public spaces of the school rather than within the teaching clusters.

Thus one might find 'learning streets', 'breakout' spaces and 'outdoor learning' environments but the primary learning environments (i.e., the classrooms) are insulated from change. In such plans traditional classrooms dominate teaching/ learning clusters while streetspace is created one level higher in the spatial assemblage. One interpretation here is that tensions between discipline and student-centred learning are resolved through an architecture that seems to provide both while retaining discipline at its depth.

The third type (Figure 4) we have called 'convertible classrooms' comprising plans where flexible walls enable two or more traditional classrooms (and perhaps adjacent

169

meeting and wet areas) to be converted into a single commons. Such plans enable a wider range of pedagogies while retaining reversibility to the traditional classroom.

The fourth type (Figure 5), 'convertible streetspace', includes plans where clusters of classrooms can be opened to streetspace as well as each other to become a larger 'commons'. Again reversibility to the traditional classroom is retained. Degrees of openability between spaces vary but we have mapped them as open when more than about half of the party wall is openable. This type resembles the second type of 'classrooms + streetscape' but enables a far greater range of pedagogies because of the capacity to convert to commons with openable walls.

Figure 5. Convertible streetspace

The final type (Figure 6) we have called the 'dedicated commons' where a protected 'commons' comprises the spatial core of a learning cluster that cannot be converted to closed classrooms without major renovation. In this case there is no clear generic diagram although a fluid transition from streetspace to commons is generally
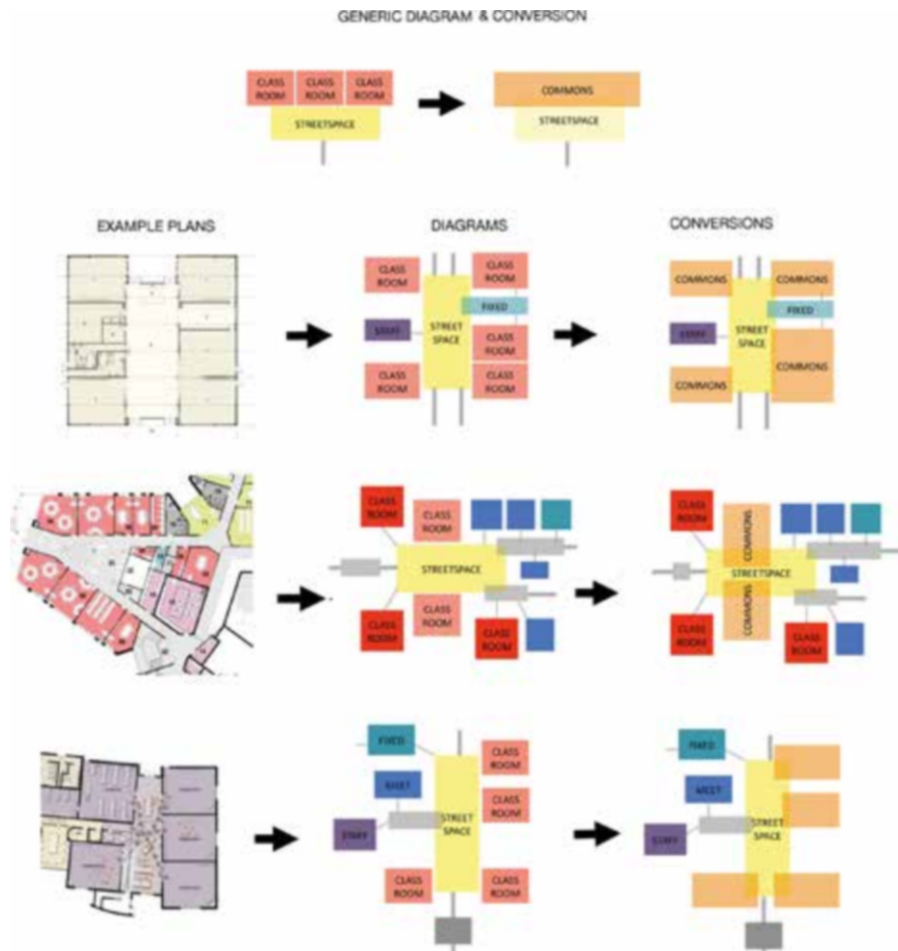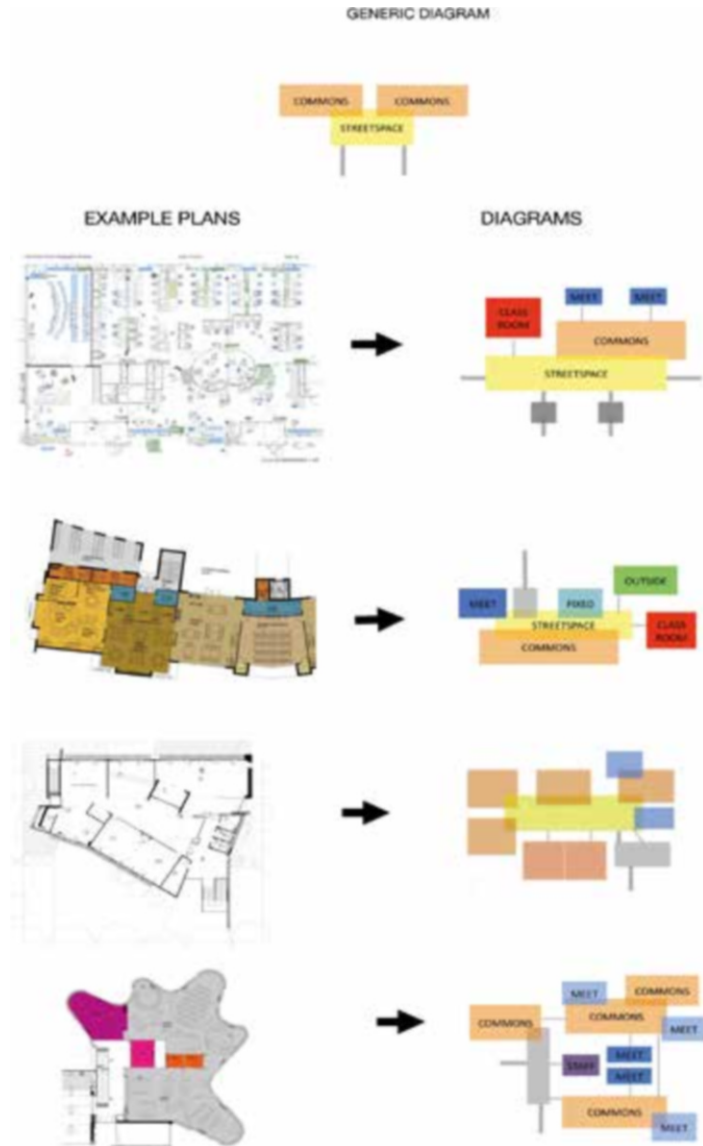

Figure 6. Dedicated commons

apparent. This category incorporates a broad range of open plans that cannot be converted to traditional classrooms—more a collection of spatial innovations than a strict spatial type since it is largely defined by what it is not. Here the bridges to traditional pedagogy are burnt and doorways are largely abandoned. It is notable, however, that some such plans have added one or two traditional classrooms as closed presentation spaces attached to the streetspace or commons.

DISCUSSION

The typology of cluster categories we have presented is highly problematic since there are many variations that lie between categories diagrammed here; these are maps and not territories, conceptual structures we find useful rather than categories we have discovered. In one sense these five types can be regarded as three, that is: the essentially traditional; the convertible; and the dedicated commons. In the end the simple typology becomes the means to understand the complexities of adaptation and assemblage.

The question of adaptability has already been used, in part, to define these plan types but it is also linked to a much larger question about what adaptability or flexibility means: the capacity for change can refer to the architectural shell, to the furniture and loose parts within it, to the people and their activities, and to the institutional regimes of control.[7] Our analysis is limited to the flexibilities enabled by the architectural shell and it is crucial here to make a distinction between two kinds of flexibility.

First is the reversible convertibility from traditional pedagogies to more constructivist pedagogies and back. Second is the ways the building enables flexible flows from one activity type to another within the constructivist pedagogy. These two kinds of adaptation – perhaps termed 'convertibility' and 'fluidity' – operate on different rhythms and at different scales of control.

The plan types we have labelled 'convertible' are those with a relatively high level of reversibility through the use of removable walls. These plans reflect the tension between pedagogies and the demand for schools that can satisfy both traditional and student-centred learning at different times. Convertibility links into higher levels of governance and longer time cycles than everyday fluidity. The adaptation from classrooms to commons may not be possible during the course of a teaching session and may be controlled by principals rather than teachers or students.

The traditional plans and dedicated commons are less adaptable in this sense than convertible types since the closed classroom constrains new pedagogies and the open plan constrains traditional teaching. Just as the classroom reproduces teacher-centred pedagogies, the irreversibility of the open plan can be construed as the use of architecture to coerce teachers into new pedagogies.

The second kind of adaptation – fluidity or perhaps 'agility' (Heppell et al., 2004) – involves the capacity for flow and change between activities within the cluster. This is enabled in part by the scale and openness of the space, yet as the

space becomes more exposed and noisy, as the classroom becomes 'commons' and then 'streetspace', it can constrain self-directed and reflective activities. In other words the openness also produces a demand for segmentarity, closure or semi-closure. One result is that many of the 'dedicated commons' type incorporate a variety of smaller segments to enable retreat – meeting rooms and alcoves but also presentation spaces. The most open of plans are often not the most adaptable because they constrain choice. In this sense fluidity is an adaptive condition produced by a conjunction of openness and closure rather than one or other end of this continuum.

The more convertible and fluid types become more complex as different spaces are added to the cluster in a variety of spatial relations (separation, openability, interpenetration). It is significant that there is no sense of convergence on any ideal architecture for the new pedagogies as there is for the old. While we have identified a simple generic diagram for the dedicated commons, there is a great deal of experimentation and diversity. Some of these plans are simple barn-like spaces where success as a learning environment becomes a difficult matter of furniture arrangement and acoustics. The danger is that open plans are cheaper to construct than segmented plans and can be supported for budgetary rather than pedagogical reasons.

The distinction between 'streetspace' and 'commons', while difficult to distinguish clearly, is an important link between plans and pedagogies. The significance of this distinction lies in the greater diversity of activities enabled in the commons, yet streetspace is far more prevalent in our sample plans than commons. One interpretation is that streetspace has become a visible face of progressive pedagogy and student-centred learning, one that can be implemented while also preserving traditional practices.

Streetspace also doubles as circulation space and is therefore easier to achieve within a strict budget when the demand for traditional classrooms must also be met. The plans of the first two types are often celebrated as innovative because they introduce streetspace at the level of the school or as an entry space, but they remain geared to traditional pedagogies.

As we noted earlier, the plans of the first two type articulate traditional pedagogies. A key finding here is that such plans account for almost half of this sample of plans that are celebrated as progressive. These plans clearly discourage constructivist pedagogies while encouraging the illusion of progressiveness. While we are not in a position to show how these spaces actually work, this study raises some significant questions.

To what degree do these plans reflect an increased competition between schools and the desire to be able to show parents a liberal educational model while affirming that the disciplinary model will prevail at a deeper level? To what degree might these become marketing spaces and is this space paid for by squeezing space within the classrooms?

Underlying this shift from teacher-centred to student-centred pedagogies is the issue of practices of power and how they are implicated in the architecture. Foucault's

173

critique of disciplinary technology insists that space becomes implicit and complicit in the production of subjectivity; the panoptic regime involves a particular spatial structure, a supervisory gaze with experiential and behavioural outcomes.

Foucault's work explains a great deal about the traditional classroom, and it also sows the seeds for understanding the architecture of student-centred pedagogies. What he termed the 'apparatus' or '*dispositif*' of power (Foucault, 1980: 194–228) became a primary source for theories of 'assemblage' (Deleuze & Guattari, 1987; DeLanda, 2006) where micro-practices of power are integrated with understandings of the ways productive self-organized assemblages emerge from dynamic interactions between parts. In this sense the movement from traditional to constructivist pedagogies and from closed classroom clusters to more open spatial assemblages can be seen to parallel the move from Foucaultian to Deleuzian conceptions and practices of power.

While all schools are stabilized by hierarchic structures (the control of the principal, teacher, curriculum and timetable); student-centred learning is based primarily in horizontal rhizomic networks of connectivity. Assemblage theory is a fundamentally constructionist account of socio-spatial relations focusing on the ways in which heterogeneous parts are assembled into a provisional whole.

The traditional classroom cluster embodies an architecture of order and surveillance that erases blurring between spaces and assigns specific tasks to specific spatial segments. Deleuzian thinking stresses connectivity, flows of desire, processes of identity formation and becoming; the spatial aspect is found in 'smooth' spaces and rhizomic or networked spatial structures.

This can be seen as a move from an assemblage of *discipline* to one of *becoming*; top-down practices of 'power *over*' make way for student-centred empowerment or 'power *to*' (Dovey, 2008: Ch. 1). Yet these new assemblages are also to site of new practices of 'power over' since many have a spatial segment designated as 'staff' incorporated into the learning cluster. While the more traditional plans tend to exclude staff areas from the cluster the more progressive plans are likely to incorporate them.

While progressive pedagogies involve more collaboration of staff with students this co-location is also linked to issues of discipline and control. In many cases this is clearly a surveillance function and some plans locate the staff area with a panoptic view over common learning spaces. Contradictory desires to both enable student-centred learning and maintain staff control can result in forms of camouflaged surveillance.

On some plans panoptic locations are designed and named as 'resources' or 'co-ordination'; in others rooms or alcoves are left blank in locations that could be appropriated for staff control. Staff often occupy an ambiguous zone on the edge of a cluster leaving the cluster as student-centred. The transformation into an open plan raises concerns about discipline that are addressed by producing new forms of surveillance—one panoptic regime is replaced by another.

There is nothing surprizing here; micropractices of power are not eradicated, rather we move from regimes of discipline to those of control (Deleuze, 1992). A key

174

question here is that of resilience – the capacity of a complex adaptive assemblage to remain dynamic and respond to change within the framework of a sustainable regime. The learning cluster must offer a resilient sense of place to be effective; not a capacity to bounce back to a stable state but rather a capacity to adapt to change without lurching into a new regime or descending into chaos. A key question lies in what kinds of plans have such resilience and remain open to new pedagogies.

Conversely which of them are effectively constructed ideologies of 'openness as freedom' that will ossify or revert to traditional classrooms in time? The most resilient of the plans are those with a diversity of learning spaces and high levels of fluidity.

There can be no getting to the bottom of this because when highly adaptive learning environments work well they retain a certain mystery and magic that is both social and spatial. While the diagrams may look systematic and formulaic this is a misconception. The diagrams have two functions, one practical and one theoretical. The practical function we have demonstrated as best we can through the analysis: it is to identify the similarities that underlie what may appear to be radically different plans in a manner that can be seen at an abstract level that both designers and educators can understand.

The level and kind of convertibility and fluidity/agility of school plans should be the subject of debate. We suggest that the diagrams can help to lift that debate from the specifics of particular plans, or ideologies of open versus closed, into a discourse of multiple plan types. For architects, who universally loathe being given template plans to copy, this leaves scope for both creative adaptation within plan types and the invention of new types. The theoretical function of the generic diagrams is that they resonate with what Deleuze and Guattari (1987) call 'abstract machines'.

We are dealing here with the immanent productive forces of assemblage, the ways that flows of desire congeal into certain socio-spatial patterns. The current plans mostly reveal contradictory desires for both traditional and student-centred pedagogies: desires for streetspace without deeper change and desires for convertibility evident in the first four types. We expect that in time the plans we identify as 'dedicated commons' will change the most. In the end it is not theory that matters here but the use of theory as a conceptual tool for the critique of practice.

The complex adaptive assemblage is a framework for re-thinking constructivist learning environments and the design of resilient schools.

We are not in a position to say which of these plans or pedagogies work – that is a question for detailed case study evaluation. Our goal is to deepen the level of engagement of both architects and educators with these issues. What we have demonstrated is that the range of plans seen as innovative from the perspective of progressive learning organizations is very broad, and that the 'openness' of such plans can be usefully conceived within a five-part typology. The typology loosely aligns with a continuum from 'traditional' closed classroooms, through a range of 'convertible' types to what we term the 'dedicated commons'.

175

We have drawn some crucial distinctions that have not been made before and that we hope can enlarge the discourse of school design. First is between two kinds of flexibility: the 'convertibility' (or 'reversibility') of plans from one pedagogy to another, versus the 'fluidity' (or 'agility') that plans enable between one spatial practice and another. Convertibility enables openness and closure – an architecture of reversible change. Fluidity is a property identified with the multiplicitous practices of student-centred pedagogies.

The traditional plans embody an architecture of reproduction but instead repackages it with the progressive streetspace for a liberal market. The convertible plans embody the tensions between traditional and constructivist pedagogies – and they may reproduce such tension.

The plans classed as dedicated commons embody the burning of bridges – the architecture of a new order, or is it chaos? As openness increases, so does the demand for retreat spaces, new forms of closure and new regimes of control. This is an ongoing story – watch this space.

NOTES

[1] This paper is part of Australian Research Council Linkage Project entitled 'Smart Green Schools'. See: *www.abp.unimelb.edu.au/research/funded/smart-green-schools/* We acknowledge the support and contributions of Clare Newton, Sue Wilks and Dominique Hes as collaborators, and Ben Cleveland and Ken Woodman as PhD students on this project.

[2] *<www.designshare.com/>* Between 2001–2010 a total of 49 awards were given for completed new buildings in the middle-school category for which data was available on the learning clusters of 41.

[3] *<www.cefpi.org>*

[4] *<www.bcse.uk.net>* The British Council for School Environments has an awards program with a similar agenda but does not publish detailed plans.

[5] Typology: Webster = study of or analysis or classification based on types or categories.

[6] For a broader account of assemblage theory and the concept of 'complex adaptive assemblage' see: Dovey (2010: Ch 2).

[7] See: Brand 1995. We acknowledge the work of Ken Woodman in helping to rethink some of these meanings within his PhD dissertation: Woodman 2011.

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177

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9. VOICES OF EXPERIENCE

*Opportunities to Influence Creatively the Designing
of School Libraries*

INTRODUCTION

The *voices of experience* study considered school libraries as social and cultural entities within the contexts of school life and of wider society, such that school library designing becomes a social interaction of concern to those influenced by its practices and outcomes. School library designing is therefore regarded as significant primarily to users such as educators and students, as well as to those with professionally accredited involvement, such as designers/architects and education facility planners. The study contends that current approaches to educational space designing, including school libraries, work to amplify the voices of accredited designers and diminish or silence the voices of users.

DIMENSIONS OF THE STORY

The *voices of experience* research story began, and has continued, as one of 'enthusiasms, puzzles and connections' (Chambers, 1985, p. 138). As a researcher, my entry point to the study followed many years of enthusiasm associated with school libraries: my own, those of educator colleagues, those of students in primary and secondary schools and those of teacher-educators undertaking post graduate study in education, particularly in the professional branch of teacher-librarianship. Added to this was the enthusiasm, sometimes of a different order, of the accredited designers/architects and education facility planners involved in school library designing projects.

While some projects of my experience involved degrees of designer/architect collaboration with long-term users, a majority of projects assumed understandings of user groups, which served to limit educator and student involvement and to ignore opportunities to explore the capacities of educators and students to participate in designing the spaces of their lives and work.

In my experience, and at the time of the study, projects were most often directed by accredited designers, architects, education facility planners and financial controllers. Within the broad Australian school-system context of the study, designing practices appeared to prioritise layers of policy, funding and financial governance and to be

driven in large part by building project time schedules. Subsumed under the weight and direction of these aspects and agents, references to dimensions such as visionary prospects for learning and teaching; key informing educational mandates; research evidence related to social, cultural and pedagogical dimensions and contemporary technologies, often appeared to be overshadowed or diminished.

With these circumstances in mind, the research examined the puzzles and mired complexity of educational space designing contexts, brought about by competing agents and influences. Questions arose for me, out of these prevailing conditions, about *who and what is valued* in the scope, participation, influences and research foundations of school library designing practices and processes. The chief concern of the study was to investigate these matters as they were raised in the literature and most particularly as they emerged in the *small stories* of the *voices of experience*, of those who have close and vested interests in school libraries (Sen, 2004; Geogakopoulu, 2007). *Small stories* can be understood to include a range of under-represented narrative activities, 'tellings of ongoing events; future or hypothetical events; allusions to tellings; deferrals of tellings and refusals to tell' (Geogakopoulu, 2007, p. vii).

Thus the study explored school library designing through the voices of those most closely involved. By engaging with four participant groups, the study presented the perspectives of those with a long-term interest, educators and students who interact daily with school libraries and information services, and of those with a short-term interest but with long-acting effects, accredited designers/architects and education facility planners, who have been traditionally and contractually engaged in the designing of new and renewed school libraries.

CONCEPTS AND INFORMING THEORIES

Key conceptualising sources for the study were Tom Heath's (1989, 2010) understanding of designing as *creative processes of discovery* and Christopher Day's (2003) *consensus designing* and *biography of place* approach. Heath's concept constitutes designing as a specialised kind of problem solving, as a discovery-focused, cyclic, interconnected and integrated set of learning processes. Heath's (1989, 2010) designing cycle is achieved in creative, strategic and tactical activities of *focusing*, *imagining, venturing* and *backtracking*. These process guide-points to designing activity enable engagement with the circumstances we confront in designing, working *to unfold, to feel our way*, and to *work our way gradually* in order to *unravel complexity:* see Figure 1.

Heath's (1989, 2010) evidence-gathering, research-focused process, the VAST Heuristic (Figure 2), invites participants into designing partnerships to create and customise the evidence-base for the designing of spaces for life and work. Concerned as it is with the lives and work of people who are closely impacted by built space projects, this conceptual and practical framework enabled the social nature of the
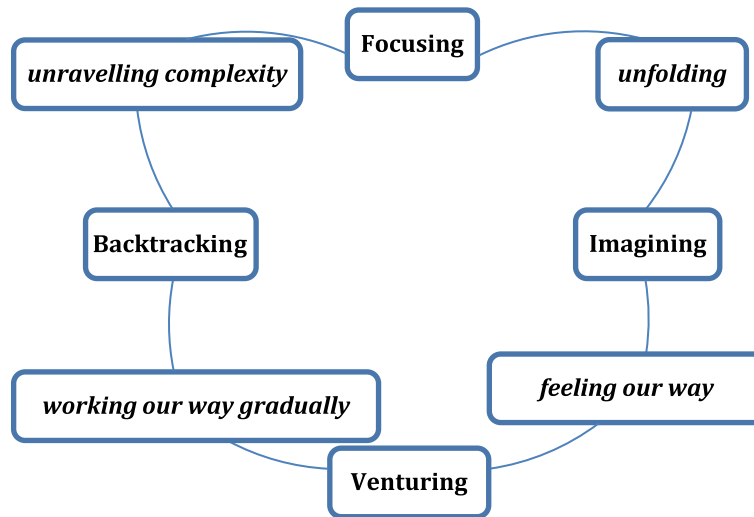
Figure 1. Designing as creative processes of discovery (Heath, 1989, 2010)
Adapted by Elliott Burns (2011)

voices of experience research and the exploration of the human interests and actions of participants (Denzin & Lincoln, 2003; Janesick, 2003).

The VAST heuristic draws on the work of John Zeisel (1984). Heath (1989) proposes the underpinning thesis of VAST as: '*people have Values, in relation to aspects [Activities] of buildings [Site/System] which must be expressed in built form [Technology]*'. Thus the VAST elements scaffold the exploration of systems of human relationships and human activity, which are then enabled by surrounding systems which support human activity within built spaces.

Heath understands designing as a *'specialised kind of problem solving'* involving strategic and tactical approaches. Designers are encouraged to apply the VAST heuristic critically and with a certain amount of *'free floating anxiety'* (Heath 1989: 17). Applied to the VAST elements, the interrogative frame of the critical theorist's question: *'who and what is valued here?'* (Popkewitz & Fendler, 1999) prompts exploration of other questions concerned with potentially influential participant relationships and activity: Who designs these spaces and what agendas are fulfilled through designer roles? How are learners imagined in the design process? How are participants influenced in the design process? How do design elements work to prohibit, permit, locate and order the ways in which learners and teachers are positioned and the ways in which learning takes place? (Foucault, 1967; Jamieson et al., 2000).

In Christopher Day's *Consensus designing: Biography of place* approach (Figure 3), spaces are considered to have a 'layered biography' expressed in

181

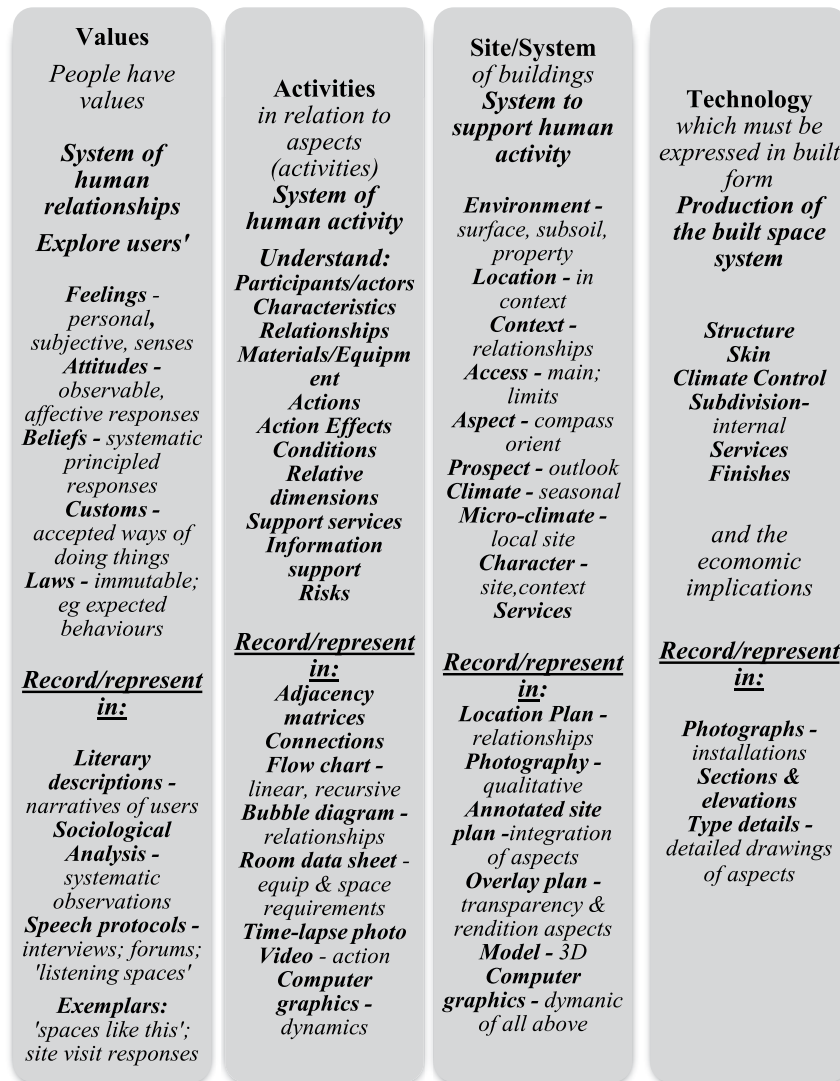| Values	Activities	Site/System	Technology
People have values	in relation to aspects (activities)	of buildings	which must be expressed in built form
System of human relationships	**System of human activity**	**System to support human activity**	**Production of the built space system**
Explore users'	**Understand:**		
Feelings - personal, subjective, senses	**Participants/actors**	**Environment** - surface, subsoil, property	
Attitudes - observable, affective responses	**Characteristics**	**Location** - in context	**Structure**
Beliefs - systematic principled responses	**Relationships**	**Context** - relationships	**Skin**
Customs - accepted ways of doing things	**Materials/Equipment**	**Access** - main; limits	**Climate Control**
Laws - immutable; eg expected behaviours	**Actions**	**Aspect** - compass orient	**Subdivision**- internal
	Action Effects	**Prospect** - outlook	**Services**
	Conditions	**Climate** - seasonal	**Finishes**
	Relative dimensions	**Micro-climate** - local site	
	Support services	**Character** - site,context	and the ecomomic implications
	Information support	**Services**	
	Risks		
Record/represent in:	**_Record/represent in:_**	**_Record/represent in:_**	**_Record/represent in:_**
Literary descriptions - narratives of users	**Adjacency matrices**	**Location Plan** - relationships	**Photographs** - installations
Sociological Analysis - systematic observations	**Connections**	**Photography** - qualitative	**Sections & elevations**
Speech protocols - interviews; forums; 'listening spaces'	**Flow chart** - linear, recursive	**Annotated site plan** -integration of aspects	**Type details** - detailed drawings of aspects
Exemplars: 'spaces like this'; site visit responses	**Bubble diagram** - relationships	**Overlay plan** - transparency & rendition aspects	
	Room data sheet - equip & space requirements	**Model** - 3D	
	Time-lapse photo	**Computer graphics** - dymanic of all above	
	Video - action		
	Computer graphics - dynamics		

Figure 2. VAST designing heuristic (Heath, 1989, 2010)
Adapted by Elliott Burns (2011)

dimensions of physicality, habitation through time, evocative of moods and feelings and with 'spirit of place identity' (Day & Parnell, 2003, p. 51).

Identity with place emerges through a mix of affective, sensory and cognitive experiences and in responses which comprise proprietary feelings (Day & Parnell, 2003). Thus aspects of place identity are best understood through the insights
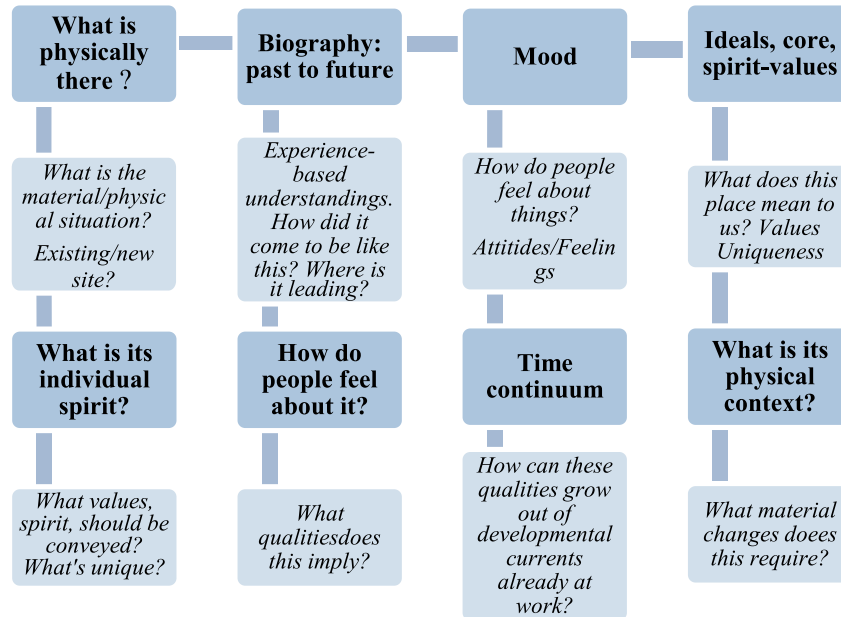
Figure 3. Decision-making matrix: Turning inspiration into action
Figure 3 is adapted by Elliott Burns (2011) from
Day, C., & Parnell, R. (2003). Consensus designing: Socially inclusive
process (p. 220). London, England: Architectural Press.

and clarity of 'the people who live there', for example students and educators, converging in dialogue with 'the people who don't', such as accredited designers (Day & Parnell, 2003, p. 11).

Day and Parnell (2003) promote participative or mediated consensus approaches to designing in which participants work towards agreement, relying on respect, the building of trust and the moderation of entrenched personal positions, involving both vernacular and specialist knowledge. The *biography of place* process incorporates values-focused designing in which people foster and evolve social cohesion through their practices of living and working in spaces and places. Designing and redesigning involves continuing processes of negotiation and construction to unfold, for example, *what could this place say?* and *what values does this imply?*

As a process of designing, a *biography of place* approach begins with the synergy of people, of places and people's relationship with places and of qualities of being and becoming. In these terms it could be said to begin from experiential-existential conceptions of designing and to incorporate practical-functional and structural-instrumental conceptions to facilitate the expression of the built spaces on the values foundations of those who will live and work in the spaces (Franz, 1998).

183

In conjunction with these informing theories, the literature and the *small stories* of participants' understandings and experiences, the research questions and the study objectives set out on a *creative process of discovery* (Heath, 1989, 2010), to *unravel complexities* of understandings about libraries, to *focus on the impacts* of framing research, contexts and practices and on the influences of those with interests in the designing of school libraries. The prospect, implications and impact of the study have been in identifying and *venturing* ways in which the processes and practices of school library designing are open to *creative possibilities* (Boyce, 2006) and the potential for *voices of experience* to exert *creative influence* (Harvey, 1996).

THE SCOPE OF STORIES

The *voices of experience* study examined understandings about libraries as evolving and influential ideas, as time-spaces in the social, cultural and political lives of people. Historical vignettes demonstrated the ways in which libraries across time have been used to facilitate social and political purposes and projects. It can be argued that the library as an idea might be traced from beyond 50,000 years ago, when human experiences and memories were inscribed on rock walls or symbolised in artefacts kept and passed between generations of people and accompanied by narrative traditions (Manguel, 1996).

The libraries of classical antiquity, Mesopotamia, China, Islam, Middle Egypt, and some in the more immediate past, suffered the destructive fates of their rulers and nation-groups. Kern (as cited in Battles, 2003) describes these dramatic disasters as *biblioclasms*. Such episodes litter the human story, their shards and remnants sometimes gathered and added to the artefact collections of descendant libraries. While the deepest intentions of the founders remain open to speculation, the practices associated with the establishment of early libraries, their material traces, serve to illustrate their sometimes visionary foundations along with the fraught and embattled scope of their social, cultural and political contexts.

However the current literature, commentary and research data supports the potential of a continuing significance for diverse library-guises as persistent, emerging sites for innovating and for reworking human experience; as 'things':

> the thing and the space it inscribes and produces … Differentiated perceptually and conceptually … distinct, repeatable in principle … located in space only because time is implicated. (Grosz, 2001, p. 170)

The key dimension of change related to school libraries, and to learners and educators in the study, was the dynamic of the pedagogy-technology nexus, which emerged as a dominant source, impetus and vehicle being brought to bear on learning and teaching in schools. In terms of influence, Fairclough (2009) draws our attention to the status of normalisation which is achieved as technologies of information and communication are projected, in government, economic, education and popular

media discourses, as the preferred globally connecting, universally beneficial catalysts for learning, teaching, communicating and belonging in the world at global, regional and personal levels.

Some courage is needed to persist in questioning and evaluating the effects of these assumptions, in the face of the ways in which living and learning in the world, including the worlds of schools, is so mediated by a pedagogy-technology dynamic. Physical-digital spatial connections loosen; spaces become technology-infused; space designing is re-ordered, or as Mitchell suggests, architecture becomes 'recombinant' (Mitchell, 1996, 2000, 2003).

While the impacts of these aspects on the spaces and places of school libraries is raised repeatedly in the literature and in the study participants' discussions, manifestations of change in the physical and virtual dimensions of school libraries can continue to be seen as evolving, as works in progress, as part of *focusing*, *venturing* and *working our way* towards creative possibilities of designing to deal with such persistent incursions and realities.

On this basis it seems reasonable to suggest that ideas of a design template or generic model of a school library would deny the potential for the being and becoming of learners in individual school contexts, and inhibit understandings of school libraries as responsive and creative *places* for learners in diverse communities and learning in diverse contexts.

METHODOLOGY AND WAYS OF TELLING

The study aimed to convey an 'interpretive portrayal of the studied world' (Charmaz, 2003, p. 314). Through a focus on the designing of school libraries as a social problem with a semiotic aspect, the study used the data analytical processes of critical discourse analysis (CDA) specifically through Bhaskar's framework of explanatory critique (Fairclough, 2001). The study identified dimensions of what is problematic and how it is problematic through an examination of 'who' and 'what' appeared to be valued in relation to school library designing, of who was included and who was excluded in taken-for-granted designing processes and practices.

Ethnographic, participant-observer research strategies facilitated the exploration of the contexts, understandings, values, sources of influence and actions of those participating in the study (Denzin, 2000). These phenomena were addressed and investigated in real-world settings with emphasis on the complex of dynamics among the sources, relationships and consequences impacting on participant understandings and actions in relation to school library designing.

Data were gathered in semi-structured interviews undertaken with individuals and small groups, in site observations and through document analysis. Through participant statements and language, the data analytical discussion examined the circumstances and obstacles related to the problem of school library designing, and considered the prospects of what might be, of what could change, with respect to the functioning of the problem as it operated to sustain existing and often contentious

social arrangements. The analysis incorporated positive critique in terms of possible ways to address the obstacles, particularly with respect to discursive opportunities, and reflected critically on the effectiveness of the analysis as it was undertaken by a participant observer researcher (Fairclough, 2001, p. 125).

Of particular value in the study has been the foregrounding of the kinds of language linked to groups, professions and identities, for example the language dimensions of professional dispositions (habitus) in fields such as architecture and education (Chouliaraki & Fairclough, 1999, pp. 116–118; Bourdieu, 2005, p. 47), and the potential impact of the language of professions on moments of designing. In this respect I sought discursive opportunities for participants to act together, engaging in dialogue, not in order to suppress difference in false compromise/consensus, but to engage and emerge 'as voices in common on particular issues' (Chouliaraki & Fairclough, 1999, p. 6), on the basis of which designing participants may act to *make and remake their lives* (Calhoun, 1995, cited in Fairclough, 1999, p. 4).

Pervasive across the study, in the research literature and in the participant data have been themes of change. Discourses of change represent libraries as evolving entities shaped by multiple influences; by historical and contemporary dimensions of culture, tradition and ethos; subject to the diverse projects and purposes of human activity; and more recently, caught in the burgeoning flow of digital and online information and media, to become multiple contemporary-immediate 'library' versions and entities. Discourses can work in a range of ways: to objectify and convey information as fact; to rhetorically project particular views and justify policies and strategies; to constitute and reproduce particular relations of power and to generate imaginary representations of possible futures (Fairclough, 2009, p. 321).

In these terms the 'ethnographic sensibility' (Pader, 2006, p. 163) and quality of the study might be evaluated by the degree to which readers are able to see a similar cultural picture to that communicated by the researcher (Glesne, 2006). Thus my hope has been that readers of the study might recognise the impacts of the evidence and the integration of the knowledge and experience forms which contribute to the study. For example, the local knowledge and experiences of the study participants, the expert knowledge from the literature and the researcher's knowledge and experience, as these meet the readers' own knowledge and experiences.

VOICES OF EXPERIENCE IN CONVERSATION

The study participants told the most pertinent stories to illustrate the challenges to and the potential for creative possibility and creative influence. It could also be noted that the participants' voices signalled a significant capacity to contribute to the evidence base for the designing of school learning spaces. In the *small stories* discussion which follows the participant voices speak (*in italics*) to illustrate the overall spirit of the data gathered in semi-structured interviews and field

observations. These small stories are available more fulsomely in the doctoral thesis transcripts (Elliott Burns, 2011).

Educator Voices

Educators' *small stories* represented school libraries as multi-dimensional synergies of learners, learning and social relationships as well as spaces and places of material dimension. Cues to the significance of school libraries were represented in figurative, symbolic-conceptual representations of the school library as *a statement of beliefs about learning and a reflection of values, mission and vision,* and as such, an embodiment of community ideals. Metaphors of *marketplace, bridge and neighbourhood* were associated with dimensions of human activity and interaction to produce an impression of a school library as a dynamic, people focused entity with reach and influence (Elliott Burns, 2011, p. 151).

These understandings were connected to discourses of learning constituted in collaborative, individual, formal and informal activity, and closely coupled with the work of educators, particularly teacher librarians, through discourses of professional knowledge and pedagogical practice. Human dimensions emerged in educators' references to the being and becoming of students as learners and in the opportunities for the expression of student identities, supported through the multi-dimensional milieu of school libraries.

Transformative influences of a school's beliefs about learning on the creation of school library spaces emerged in the relational connections made between *the school's philosophy of total learner development,* as a purposeful foundation for a school library which was *designed with the learners in mind,* and with an extended scope of *extra curriculum and community overlaid.* These interdependent aspects were expressed in the transforming ideal of *a community of learners* (Elliott Burns, 2011, p. 154).

Discursive opportunities and relationships achieved key significance in educators' discussions as pivots for both designing possibilities and limitations. Designing was constituted and diversely expressed by educators, in terms of vision, leadership, relationships and communication.

In some situations, discourses of constraint were evident in competing knowledge and varied understandings about experience/expertise and roles in designing endeavours. For educators this was most particularly a concern in coming to terms with the roles and responsibilities of accredited designers / architects. Some educators speculated on whether accredited designers believed educators had any role in informing designing activities.

One teacher suggested that the architect's own views about the designing of the space would prevail *given that they're very much into their own designing and putting their mark on it.* These circumstances created a puzzling emotional conundrum. *I mean we, you feel so privileged to be in something so new and so wonderful and then you think 'why didn't they listen to the people?'* (Elliott Burns, 2011, p. 174).

187

Such limitations were seen by some educators to be influenced by established policy and status quo processes, to produce communication difficulties and to inhibit designing relationships. The weight of these influences often required resourceful responses and sometimes resignation and compromise by educators to accept less desired built-space options.

In other circumstances, discourses of creativity connected the dispositions of education and architecture in circumstances of negotiated, productive designing engagement between educators, communities and architects/designers. In one school, *the library re-design went through several transitions.* Opportunities for dialogue included *a curriculum council, a conference and staff engagement with discussions about pedagogies,* to produce a dove-tailing effect, *so that the spaces actually came out of the thinking that everyone was doing* (Elliott Burns, 2001, p. 168). Across the discussions educators' rich pedagogical knowledge and *small story* experiences as dweller-designers signalled their considerable capacities to inform designing activity in company with school communities and accredited designers.

Student Voices

Students' *small stories* conveyed interpretations of their beliefs and philosophy, vision, values and desires about school libraries. Dimensions and attributes of culture, experiences and practices, conceptual and material organisation and social relationships and processes emerged in students' discussions about the characteristics of school libraries: *it's sort of like an education playground* (Elliott Burns, 2011, p. 185).

In some of the students' *small stories*, school libraries were discussed in discourses of creativity, such that the spaces were understood as specific to them and customised particularly for them, as young people.

Our library speaks of young people. The colours and the furniture are sort of young – not like the old library that was brick inside and had sort of old furniture. You feel like it (the new library) was made for you because of the colours and things (Elliott Burns, 2011, p. 192).

In other renditions, school libraries were seen to constrain the desired expression of student identities through the use of particular spatial configurations and materials, and in spatial design outcomes which kept them under surveillance. A particular and repeated example was student commentary on the use of glass as a building material.

All the rooms in the library have glass, so it's hard to be private to work by yourself. The glass is a distraction, it feels as if you are being watched (Elliott Burns, 2011, p. 192).

Thus, interpretations of glass as 'transparency, visibility and light' can also be read as 'supervision, surveillance and privacy-intrusion'. Student discussions included pleas for the inclusion of private spaces for learning as an alternative among current predominantly collaborative, group-based learning space options. This dimension of

concern for students calls to mind a *multitude-solitude* balance, 'the existential state in which I keep myself company' (Arendt, in Mudie, p. 32), offering opportunities for inner dialogue and the nurturing of identity.

> To design for solitude is not to create spaces for self-indulgence, but rather to give ample consideration to what the self might need for the full realisation of our potential as thinking, conscious individuals. (Mudie, 2012, p. 34)

Students' discussions were also connected to discourses of change, education, learning, social relationships and spatiality, as ways to explain and evaluate the potential for them to participate in the designing of the spaces and places of their lives and work as learners. Students' *small stories* demonstrated capacities for conceptualising, description, evaluation, questioning and critique. Their capacities to reflect on matters of learning spaces and designing, and their familiarity as prime users of school libraries, suggests that students can be adept and creative participants in designing dialogues.

Designer/Architect Voices

Only one of the three participant designers/architects was able to draw on discourses of learning and teaching to exemplify understandings about learners' relationships with school libraries and to reflect on broader matters of education. In this circumstance school libraries were represented as *sites of re-invention,* changing and evolving to give effect to a *transformational shift* in resources, access and operations (Elliott Burns, 2011, p. 203). It is worth noting that this participant had undertaken a cross-disciplinary, architecture-education post-graduate research project.

Historical perspectives characterised one architect's position: *libraries are very different to our day in the sixties or seventies, there's a lot more going on. It is a week-to-week moveable feast in the IT area. It's important to stay in touch with that. You have to get the bones of cabling right* (Elliott Burns, 2011, p. 206). In this regard, knowledge and experience gaps could be said to constitute voids in understandings and to inhibit capacities to imagine the designed outcomes of school libraries from the standpoints of those most closely associated with learning endeavours in these spaces and places.

In the remaining discussions, the designers/architects' limited pedagogical knowledge, absence of references to a research focus and partial understandings about relationships among learners, learning and school libraries were the most significant elements.

Discourses of constraint appeared to predominate as designers/architects conveyed their understandings and described their practices related to the designing of school libraries and other school learning spaces.

Responsibility for the *sometimes far too institutional and far too segregated features of schools* was viewed as a result of expressions of designing which produced

189

an almost prison-like functionality and appearance. A lot of the environments we design for students are far too austere. Making *libraries and whole school precincts as nice places to be would improve the experience of what it's like to be at school* (Elliott Burns, 2011, p. 222).

In these renditions relations of power can be seen to produce, and to reproduce, status quo processes through the implementation of policies, stages and standards of built-space practices, and the imposition of time schedules and accountability requirements of governments and school systems.

Thus status quo processes can work to constrain opportunities for designing partnerships with educators and students as the users of educational spaces, and to confine participation to reactive responses or in some cases to mediate actively against participation.

Education Facility Planner Voices

In a similar unfolding, only one of the three participant education facility planners (an earlier career teacher) was able to draw on discourses and experiences of education to convey resonant understandings of school libraries, learners and learning. School libraries were regarded as *model sites where the epitome of learning examples in the school should be.* School libraries were sites *being transformed,* as vanguard IT sites in the school and as sites for the *modelling of inquiry learning* (Elliott Burns, 2011, p. 230).

The two remaining educational facility planners resisted comment, disclaiming the field of education as one in which they needed or had experience/expertise, consigning concerns about matters of education to others. In relation to the designing and building of a school library in a newly developed site, one participant stated, *I'm just one of the cogs in the wheel; somewhere between the demographics and the appointment of the Principal* (Elliott Burns, 2011, p. 235).

In the cases of two of the education facility planners their comments on matters of education, learning and teaching were limited to illustrative, narrative scenarios of recent experience to connect these dimensions.

For the education facility planners in the study much of their designing activity appeared to be framed within discourses of constraint, characterised by system and governance processes, and by particular understandings about designing roles and participation. Education facility planner responsibilities were framed and evaluated in statements such as, *the delivery and provision is what I'm most concerned about. We're constrained, as I said by delivering a building, so that's what my job is about. It's about built environment, the delivery of the provision. Square metres are set by Canberra and the dollars are effectively set by the BGA (Grant Authority), so that'll be a dollar rate for building a so called library resource centre* (Elliott Burns, 2011, p. 243).

Even for the participant with teaching experience, system processes and governance had assumed a priority position in the practices and implementation of

the role of education facility planner, *I've got to massage everything so it comes out the right way* (Elliott Burns, 2011, p. 235).

Across this group, variations and limitations in pedagogical knowledge and experiences suggest that there is unrealised potential for this role to build knowledge about learners, learning and libraries and to engage with relevant research, to inform more productively the processes of designing.

KNOWLEDGE AND EXPERIENCE GAPS

Variations in language and dispositional foci are noted by Mayes (2010, p. 194) as asymmetries which operate at *levels of participation, interaction, institutional know-how, knowledge and rights of access to knowledge*. Mayes (2010) suggests that asymmetries can be seen to signal gaps and silences across participant groups with respect to knowledge about particular matters and can be understood as dimensions of power, in omission or commission, which arise through interactions across groups.

In these respects, competing discourses of creativity and constraint could be suggested as catalysts for creative tension. Even within current conditions, the potential fluidity of some system conditions characterised in certain participants' *small stories*, presents opportunities to explore and unravel creative possibilities and to suggest potential for creative influence (Harvey, 1996).

However, knowledge and experience gaps can constitute discursive barriers in designing relationships as participants from different fields of practice meet in, or indeed are absent from, shared designing endeavours. The implications for communication and for designing outcomes may be considerable, if for example, designer/architects, education facility planners and financial project managers assume, misunderstand, overlook or ignore users of educational spaces and the elements which are of significance to them and in which accredited designers exert customarily dominant designing roles and project leadership.

CREATING EVIDENCE-BASED DESIGNING OPPORTUNITIES

The strength and richness of participant discussion in the *voices* study supports the potential for evidence-based designing opportunities to emerge in dialogic, interrogative designing approaches which create and reference a foundation in contemporary learning space design research and which invite the inclusion of both user learning communities and accredited design professionals (Elliott Burns, 2011).

To achieve an emphasis on designing as dialogic, cyclic, renewing and reflective processes, I have chosen to use the descriptor 'evidence-based *designing*' rather than 'evidence-based design'. As noted in the *voices* study, Heath's (1989) designing cycle of venturing and refinement, involves a mix of excitement and discipline in creative processes of learning and discovery. My emphasis on *designing* is further underpinned by a perspective that the designing of spaces for learning and teaching is

not a once-for-all activity, and that social, pedagogical and technological dimensions are among the quotidian and evolving influences on the learning spaces of schools in particular. This suggests continuing proactive and responsive agency in designing by those who live and work in the spaces of schools.

The earlier reference to asymmetries at *levels of participation, interaction, institutional know-how, knowledge, and rights of access to knowledge* (Mayes, 2010, p. 194), suggests avenues to address potential knowledge and experience gaps and to bridge disciplinary-related understandings between the fields of practice of education and architecture, around matters of educational space designing. Newton and Fisher's (2009) glossary of architectural and educational terms addresses one possibility of bridge-building across knowledge gaps with respect to terminology-as-discourse and for enhanced, collaborative meaning-making in designing contexts.

Discursive opportunities of a more systematic order, exemplified in the evidence-based practices of translational research and planning roles in the health sector, could offer more focused opportunities for role-specific, mediated engagement between accredited designers and educators, bringing to bear a diversity of specialised cultural, social, conceptual and linguistic resources in designing dialogue (Fisher, 2013). A particular example is the 8-step Evidence-Based Design process and planning cycle outlined by Malkin (2008, p. 17) and the Centre of Health Design www.healthdesign.org/chd.

The health sector Evidence-Based Design process referenced by Fisher (2013, p. 141) develops systematic precursors to built space projects through *organisational readiness; defining goals and objectives*; *sourcing* and *critical evaluation of relevant research*; *innovation on evidence-based concepts* and *development of baseline performance measures.* These pre-construction concentrations provide significant data/evidence to inform the designing of built spaces and the evaluation of post-occupancy performance.

In a similar way for example, Heath's (1989, 2010) qualitative, discovery-focused, evidence-gathering framework, the VAST heuristic, pays attention to a scope of evidence as a foundation for built space design decision-making. Heath's process was explored at some length in the *voices* study and can be regarded as a way of connecting and translating the *values* and relationships of users and their desire for capacity to enact a particular range of human *activities*, with practical considerations about the *sites and systems* required to support their endeavours and the *technologies* required to produce the most effective and satisfying built space forms. Each of the VAST elements and their issuing synergistic relationships implies a data-information-knowledge-wisdom flow and an evidence-cycle of imagining-visioning, of research through the literature and in the field, of monitored implementation and of post occupancy evaluation.

Recognition of diversity in designing endeavours invites foundation consideration of experiential-existential questions of: 'who are you?', 'how are you?', 'what does/might this place mean to/for you?' balanced with those

practical-instrumental matters of activity and 'doing' concerned with functional and structural questions about 'what do you want to do here?' Thus experiential-existential interrogative exploration leads to more instrumental questions of 'and so then, how would you like to live and work here?'

Taken together, Day's *consensus designing* approach (2003), Heath's VAST heuristic (1989, 2010), and the Evidence-Based Designing model cited by Fisher (2013), share a heavy reliance on dialogue and negotiation, and on the inclusion of the voices of dwellers and users as designers in partnership with accredited designers. Designing approaches which grow out of users' contexts may be more difficult courses of action in circumstances where status quo approaches are ingrained, assumed and unquestioned, or when system processes override wider involvement beyond accredited designer roles.

In the developing of shared understandings attention needs to be paid to diversity of perspectives, and variations of needs and desires. As *continuing processes of designing,* these examples have potential to inform the daily, ongoing adaptations, flows of people, interactions and information which have become characteristic of school learning environments. Such adaptations extend beyond the inauguration of new built space projects or substantial refurbishments and into the realm of everyday reworking in response to changing requirements. Such evolving processes invite users to *come as you are with your values, contexts and desires;* to make and remake the places and spaces of their lives and work.

CAPACITY-BUILDING TO FOSTER EVIDENCE-BASED DESIGNING

Pursuant to these possibilities, the *voices* research highlighted the unit of study 'Designing spaces for learning' in the Master of Education (MEd) at Queensland University of Technology (QUT), as an example of an opportunity for discursive and creative positioning of educators to motivate and inspire learning space designing participation. The MEd study program concentrates on knowledge and experience building with educators, for whom there has been previously no prospect in their pre-service and post-graduate programs, to consider matters of space, place and designing related to the influence of educational spaces on student learning and on their own pedagogical practices.

The MEd study program operates in something of an intermediary position, inviting educator and designer / architect participation in forums and site visits and offering accredited designers opportunities for engagement with educators away from the pressured schedules of 'live/real' built space projects. Such collaboration presents opportunities to foster educators' and designer / architects' understandings and to apply these within the contexts of conceptual and professional work.

The intermediary position has the potential to foster the 'knowledge partnerships' referenced by Fisher (2013) and integrated within the health sector Evidence-Based Design exemplar noted earlier in the chapter. It could be argued that recognition of the value in 'knowledges' from different disciplines might enable respectful balance

in partnerships at the tables of design decision-making for the spaces of learning and teaching.

At the research level, particular examples of capacity building include projects through research centres such as the Learning Environments Applied Research Network (LEARN) at the University of Melbourne (Victoria, Australia) http://learnetwork.edu.au/ At the Queensland University of Technology, the Children and Youth Research Centre's program 'Environments for Work and Play' supports innovative and high-impact research in this area, with a particular focus on children and youth, their families, and communities. http://cryc.qut.edu.au/

Studies such as 'Reimagining learning spaces' (Bland, Hughes, & Willis, 2013) undertaken by Queensland University of Technology researchers and funded by the Queensland Council for Social Science Innovation, gathered educator and student perspectives as an evidence-base to inform the designing and use of school facilities and to examine the relationship between school building construction and pedagogy.

The *reimagining* study focused on new school libraries established during the period of the Australian National Government initiative 'Building the Education Revolution' and integrated themes of imagining, transitioning, experiencing and re-imagining. Recommendations from the study overlap a range of encouragements and outcomes of a number of studies including those of the *voices of experience* research. These include encouragements to user participation in designing and creating spaces customised for individual communities; encouragements to communication and collaboration among those with accredited professional and user investment in learning spaces and encouragements to evaluation of process, practice and facility-experiences through post-occupancy reflection.

Most pertinently these encouragements include the investment of time – 'lead time' for learning space project preparation (Bland, Hughes, & Willis, 2013, p. 144); time for 'organisational readiness' (Fisher, 2013, p. 141); time to evaluate and build on aspects of evidence through critical analysis of research; time to understand the values-foundation of the educational organisation or school/s involved; time to challenge and negotiate pressured time schedules imposed by system and governance requirements and project deadlines (Elliott Burns, 2011).

Continuing discursive opportunities through interdisciplinary research would usefully involve connections among professional associations of education, architecture and design, universities and research centres. Learning space designing research has built a more intense international profile since Lackney's (1996, 2001) early influential foundation studies. Australia does not have a long history of research in learning space designing.

However, with partnerships established through university-based research centres, generative funding opportunities and key programs in progress, Australian educators, architects and designers are well placed to engage in long-term, in-situ, cycles of research, implementation and reflection. Interdisciplinary research offers collaborative opportunities for the 'capacity building' commended by Parnell, Cave and Torrington (2008, p. 218).

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TERRY BYERS AND WESLEY IMMS

10. EVALUATING THE CHANGE IN SPACE IN A TECHNOLOGY-ENABLED PRIMARY YEARS SETTING

INTRODUCTION

There has been considerable attention in the literature postulating the potential effects of contemporary, technology-enabled new generation learning spaces (NGLS) on both teaching and learning (Brooks, 2011, 2012). This has, in part, been driven by the pervasive and transformative potential of ubiquitous access to and use of digital technology in the classroom (Chan et al., 2006).

Increased access to mobile technology in recent years has freed students from the restrictive nature of shared access in traditional computer laboratories (Blackmore, Bateman, O'Mara, & Loughlin, 2011). Students now have personal 'anywhere, anytime' access to a boundless library of highly indexed information (Beichner, 2014), which in turn challenges the highly sequential style of instruction that has allowed teachers to preserve their historically authoritative role.

Personal access to technology can support more adaptive and connected learning experiences. These experiences are created by connecting teachers and students within multimodalities of teaching and learning that may have not been possible before (Bocconi, Kampylis, & Punie, 2012; Hall-van den Elsen & Palaskas, 2014; Swan, van'T Hooft, Kratcoski, & Schenker, 2007). Multimodalities afford teachers the ability to orchestrate adaptive learning opportunities using a range of physical, text and visual tools, whilst connecting students with each other.

A key element is the connectivity between teachers-students and students-students is established through the creation of technology-enabled NGLS. The technology-enabled spaces have ubiquitous access to digital technology through one-to-one digital devices connected through wireless infrastructure.

The affordances of a NGLS environment has the potential to revolutionize how, where and with whom students learn (Mouza & Lavigne, 2013; Thomas & Brown, 2011). It has the potential to support contemporary pedagogical practices that facilitate highly personalised models of student learning (Bocconi et al., 2012; Magee, 2009; Zandvliet & Fraser, 2004). This personalised model includes learning outside the primacy of the traditional classroom forum (Mouza & Lavigne, 2013). Together these elements intertwine to create a model of teaching and learning that can be radically different to prevailing school cultures (Mouza & Lavigne, 2013).

Despite this potential, many have argued that digital technology has often been imposed on traditional classroom spaces (Bautisa & Borges, 2013; Chandler, 2009; Sawyer, 2006), which have changed little in configuration, structure and operation for the best part of a century (Burke & Grosvenor, 2008). New technologies in these traditional spaces have a tendency to sustain and reinforce existing pedagogical practices (Fisher, 2010; Lippman, 2010; Richards, 2006).

An example of this imposition is the integration of interactive white boards (IWB) into primary or elementary year classrooms. IWB have experienced a high level of interest over the past 20 years and are now commonplace. This success has arguably stemmed in part from an ability to afford both teachers and students access to visually appealing, interactive and dynamic electronic content.

A review by Higgins, Hall, Wall, Woolner, and McCaughey (2005) raised concerns that some teachers have merely 'bolted on' a slightly more impressive display format to their existing stand-and-deliver pedagogical approach, the underlying assumption being that "technology is something that you add on to existing pedagogy, and vice versa" (Richards, 2006, p. 240). This continues and reinforces existing pedagogical practices, and works against any transformative potential of digital technologies (Hughes, Thomas, & Scharber, 2006; Lippman, 2010; Mishra & Koehler, 2006).

For digital technology to act as a catalyst for pedagogical transformation it must be integrated within, rather than imposed upon, a dynamic and responsive learning environment (Cleveland, 2011; Higgins, Xiao, & Katsipataki, 2012; Lippman, 2010; Radcliffe, Wilson, Powell, & Tibbetts, 2008). Such approaches are scarce – Bautista and Borges (2013) are critical of a virtually non-existent discourse concerning this alignment of the physical attributes of the classroom to support the intensive integration of digital devices. Such silence arguably stems from a dearth of hard evidence concerning the impact of technology on teaching and learning within NGLS (Blackmore et al., 2011; Brooks, 2011; Painter et al., 2013). Little is known about how and why the physical attributes of these technology-enabled and contemporary spaces affect the nuances of the teaching and learning processes (Chandler, 2009; Upitis, 2009).

This chapter attempts to partly fill this void in our knowledge. It reports an empirical study that explored how interaction between space and digital technology affected teaching and learning in two primary or elementary years settings. A synthesised quasi-experimental and Single Subject Research Design (SSRD) approach compared student perceptions of the effectiveness of technology, their learning experiences and levels of engagement within a traditional and a NGLS classroom space.

It replicates the data analysis techniques applied in previous studies (Byers, Imms, & Hartnell-Young, 2014; Byers & Imms, 2014) that identified statistically significant changes in student perceptions in each of the spaces. This study supports findings from these earlier studies, which argued the physical learning environment acted as a mechanism to either hinder or support pedagogical practices within

technology-enhanced environments. In addition this study provides further evidence supporting the credibility of this unique methodological approach, arguing it offers the capacity to generate much needed robust empirical data on the evaluation of physical learning spaces.

LITERATURE REVIEW

The Transformative Potential of Digital Technology in the Classroom

In Australia much attention has been placed on the integration of technology in senior secondary classrooms, initially under that country's federally funded program called the Digital Education Revolution (DER) and more recently through 1-to-1 or Bring Your Own Device (BYOD) programs. Collectively these programs have seen the swift proliferation of digital devices into the secondary years of schooling.

Their aim is to create technology-enabled learning environments by facilitating ubiquitous student and teacher access to and connection through technology. Buchanan (2011) has described this proliferation as the culmination of the *digital turn* that has swept through education over the past two decades.

A number of researchers have postulated that ubiquitous teacher and student access to technology has the potential to be a mechanism to facilitate and drive innovative teaching and creative learning (e.g., Bautista & Borges, 2013; Richards, 2006; Rosen & Beck-Hill, 2012). The inherent affordances of digital technology provide teachers with avenues to accommodate a wider range of learning modalities (Bautista & Borges, 2013; Rosen & Beck-Hill, 2012). The modalities can extend beyond the traditional uni-modal approach, which draws on a model of instruction that predominately operates at the transmission end of the learning continuum, to better support a dynamic suite of multimodal pedagogical approaches (Hermans, Tondeur, van Braak, & Valcke, 2008; Hildebrand, 1999; Upitis, 2004; Zucker, 2007). This suite enables teachers to align the right digital tool/s to support the most pedagogically appropriate approach/es to facilitate the desired learning intent and/or outcomes.

This alignment between the capacities of digital technology can foster a new culture of student-centred learning (Bautista & Borges, 2013; Hermans et al., 2008). Here the students are at the heart of the process and participating in ways that were not possible before (Bautista & Borges, 2013). Unlike the hierarchical and consistent uni-modal approach, there is the ability to transition to more flexible, personalised and adaptive approaches (Jessop, Gubby, & Smith, 2012). With greater flexibility comes the ability to accommodate a wider variety of more collaborative learning modalities (Blin & Munro, 2008). In this more student-centric approach, learning is more authentic, responsive and conceived as a social process (Blin & Munro, 2008).

This social-constructive learning environment supports students in learning new information and behaviours from one another, in addition to their teacher (Lin, Wang, & Lin, 2012). This requires a shift in the traditional role as the sole source of new knowledge. Instead, students access the collective expertise of a wider audience.

Student can learn from their peers and others, inside or outside the confines of their classroom or school. These informal peer-to-peer or expert-to-novice interactions lead to learners learning from each other (Bautista & Borges, 2013).

Integration of Digital Technology into the Primary Year's Space

In Australia the primary or elementary years of schooling have not received the same level of systemic funding as secondary years to provide improved student access to technology. This lack of systemic funding has not limited the broad integration of or enthusiasm for digital technology into primary or elementary years classrooms.

Many schools, and their parental communities, have funded their own purchase of mobile digital devices for use in the classroom. The enthusiasm behind this self-funded integration is unlikely to diminish in the near future. This integration is driven by a general belief in the wider community that digital technology can offer new teaching and learning opportunities and modalities.

This enthusiasm is evident in the somewhat fervent adoption of tablet and iPad devices (Higgins et al., 2012). Unlike in one-to-one or BYOD programs, these portable and touch-based devices are usually shared between students and/or classes. Compared to laptops, these devices are more suited to the learning needs and the 'technologic' capacity of primary year students. Their size, use of versatile apps and touch-based nature enable students to easily manipulate and interact with learning objects to make learning active and participatory (Hur & Oh, 2012).

This style of touch-based learning has been established in the primary years for quite some time through the use of interactive white boards (IWB).

IWBs have received widespread systemic endorsement and funding (Condie & Munro, 2007; Higgins, Beauchamp, & Miller, 2007; Wood & Ashfield, 2008). This has enabled IWBs to become the most common 'technology' found in primary years learning spaces due to their ability to facilitate whole-class pedagogy (Higgins et al., 2007). Higgins et al. (2005) and (2007) studies found that their use correlated to a positive impact on student engagement and attention and served as a catalyst for teacher pedagogical change. However, McCarter and Woolner (2011) are of the view that this shift to a whole class, teacher-centric pedagogy, supported by an IWB, does suggest that the arrangement of the classroom is now being led by technology rather than pedagogy.

The Imposition of Digital Technology as a Trojan Horse

If indeed there is a 'digital turn' in process as argued by Buchanan (2011), this may explain the perception that there is a growing dependence in primary or elementary schools on digital technology within everyday teaching and learning (Prieto, Dlab, Gutiérrez, Abdulwahed, & Balid, 2011).

Certainly research is beginning to claim that technology can be a catalyst that will transform teaching and student learning experiences and ultimately improve learning

outcomes (Donovan, Green, & Hartley, 2010; Matzen & Edmunds, 2007). This is largely a technocentric belief that integration of technology is a 'Trojan horse', a way of surreptitiously eliciting paradigmatic change in teaching and learning (Harris, 2005; Hermans et al., 2008; Rosen & Beck-Hill, 2012; Watson, 2006). This rather ambitious claim requires evidence to prove its credibility.

What is less conjectural is that the imposition of technology into unchanged spaces typically leads to technology operating within unchanged pedagogical modes (Bautista & Borges, 2013; Blin & Munro, 2008; Lippman, 2010; Richards, 2006). For Hughes (2005) the use of "technology serves merely as a different means to the same instructional end" (p. 1617). In essence this replication of already functioning instructional methods and learning processes changes the medium or mechanism used to achieve an established process (Hughes et al., 2006). It is argued that this peripheral teacher use of technology is a result of the lack of knowledge, beliefs and requisite support frameworks (Rosen & Beck-Hill, 2012).

For teachers to either amplify existing practices or innovate through exploiting the transformative potential of technology, there is a need to examine the complexity of factors and the confounding variables that influence both teaching and learning (Donovan et al., 2010; Ross, Morrison, & Lowther, 2010).

Here it is clear that the adoption and use of technology is dependent on a teacher's set of beliefs, ingrained knowledge and teaching ability (e.g., Bingimlas, 2009; Weston & Bain, 2010). Cuban (2001) and Bebell and Kay (2010) have described teachers as gatekeepers to their classroom and therefore student technology usage.

Only when a teacher's pedagogical practice is at the heart of any intervention or reform, will it be possible to observe the consequential flow on to enhancing student engagement and learning outcomes (Ross et al., 2010).

The Built Pedagogical Contract Created by the Imposition of Technology

The integration of IWB and other technologies into existing structures has been symbolic of this top-down imposition of technology. Too often the integration of technology has been a mere add-on to existing structures (Richards, 2006). Fisher (2010) argued that any lack of profound change was due to the misalignment of affordances of technology and the supposed common traditional didactic instructional setting.

This misalignment steams from a *deep spatial silence* around the hidden effects of the physical learning environment, he claims. It is the influence of these surreptitious effects that has a significant role in preventing the effective implementation of technology and to support multimodal pedagogical practices (Fisher, 2004; Lippman, 2010).

The integration of singular-focal point technologies, such as IWB, has typified this lack of alignment. Like the blackboard and whiteboard that preceded it, the IWB's front and central location dominates the classroom space. This front, central focal point continues what Reynard (2009) has described as the *fireplace syndrome*.

203

The organisation of furniture and pedagogy around this focal point, has established a highly consistent pedagogical script (Reynard, 2009; Wilks, 2009).

This script and its relationship to the physical classroom environment is encapsulated by the concept of built pedagogy developed by Monahan (2002). Built pedagogy is defined as the ability of the cultural, psychological and behavioural characteristics of the physical space to shape teacher practice and student learning (Monahan, 2002). As the traditional teacher-centric classroom has remained largely unchanged, so has its built pedagogy. This lack of change is a key factor in the highly consistent uni-modal pedagogical script between teachers and students (Wilks, 2009).

This script has been so consistent that it has established an entrenched 'built pedagogical contract' that has set the tone for what is perceived to be quality teaching and learning (Hildebrand, 1999; Wilks, 2009). This hegemonic pedagogical practice has set a clear and dominating educational equation between student(s) and teacher(s) (Hildebrand, 1999). In this equation the teachers are obligated to be the transmitters knowledge, while students are the passive receivers and consumers of this knowledge (Cleveland, 2009; Reynard, 2009). As long as this equation is unchallenged then the potential of different or innovative practices, such as the integration of ubiquitous access to technology, will never be maximized (Hildebrand, 1999; Reynard, 2009).

If the innovative potential of digital technology in education is to be realized, then the hegemonic or 'natural' teacher practices must be challenged (Hildebrand, 1999). These inherent practices are of central importance to the concept of what teachers, and to a lesser extent students, constitutes quality teaching and learning (Johnston, Ottenbacher, & Reichardt, 1995; Hildebrand, 1999) has seen that innovative teaching practices, and therefore attempts of paradigmatic reform, have been largely unsuccessful as they explicitly and implicitly contest the underlying metaphors of this hegemonic practice. By challenging the status quo this results in resistance by teachers and/or students, as they are uncomfortable with transgressions in their perception of the norms of the teaching and learning contract (Hildebrand, 1999). Fullan, Hill, and Crevola (2007) have described how this resistance is responsible for the entrenched and perpetuating resident pedagogical culture within schools and the classroom (Fullan et al., 2007). This powerful culture innately resists change to maintain the status quo (Fullan et al., 2007; Hughes, 2010; Jacklin, 2000; McGregor, 2004; Upitis, 2004; Wilks, 2009).

What is required is evidence that transforming the spatial arrangements of a classroom has a demonstrable effect on effective use of technologies. This may or may not be facilitated by changed pedagogic practices. It may or may not be caused by students being freed from some supposed student/teacher contract created by didactic oriented classrooms. What is of interest, and thus the focus of this study, is the simple question – if you move a primary or elementary teacher and his/her students from a didactic-oriented classroom into a technology-enabled NGLS, is there a measurable change in their effective use of technologies?

THE STUDY

The Spaces

The study took place within two buildings. The first housed the students' General Learning Area (GLA) homeroom constructed between 1950 and 1960. The four classrooms in this building utilised for the baseline and withdrawal periods would be considered 'traditional' in layout. Individual student desks were set in a combination of small rows (2 to 3 desks) or clustered in small groups, facing a teaching position at the centre-front of the room. This space was delineated by the teacher desk and IWB. The integration of the IWB and wireless infrastructure were recent additions to these spaces. This enabled the teacher and shared student Tablet PCs to connect to the school's network and Internet.

The second building was a recently refurbished building that housed the library, which had within its structure a 'Place of Discovery' or POD.

This POD utilised NGLS principles designed, implemented and evaluated in the Byers et al. (2014) and Byers and Imms (2014) studies. NGLS are complete and interactive 360° learning environments created through a 'polycentric layout' (Figure 1). A polycentric layout is created by multiple teacher and student focal points. The aim was to remove or de-emphasise Reynold's (2009) 'fireplace' at the front of the room. This multiple focal point layout was created using TOWs – large TV's on Walls/Wheels (Lippman, 2013; Miller-Cochran & Gierdowski, 2013), 'writeable walls' and multiple teacher data projector inputs. The notion of a polycentric layout was inspired by success of their implementation in the North Carolina State University's Student-Centred Activities for Large Enrolment Undergraduate Program (SCALE-UP), Massachusetts Institute of Technology's Technology Enabled Active Learning (TEAL) project; and University of Minnesota's Active Learning Classrooms (ALC) projects.
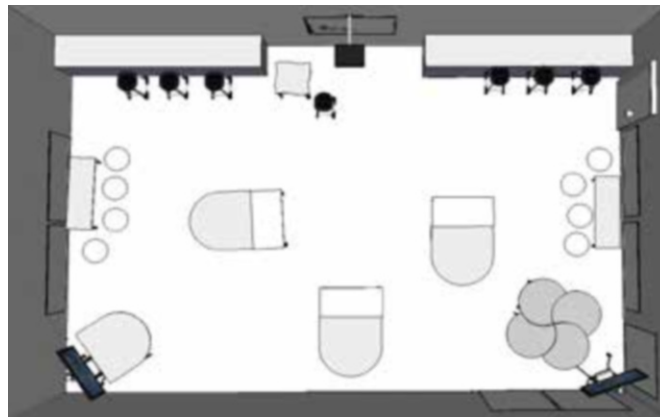

Figure 1. Polycentric layout of a NGLS

In an improvement on the original NGLS design, the flexibility of the space was enhanced through manipulation of desk heights. The combination of 'floor', 'sitting' and 'standing' desk heights delineated the visual perspective of the space. The aim was to create both traditional and non-traditional seating option, support student and teacher movement and allow students to work with greater comfort. Collectively the aim was to afford the teacher the ability to create different spatial configurations to match the pedagogical intent of the lesson or activity (Brooks, 2012; Byers et al., 2014). (The traditional 'one seat per student' infrastructure was also ignored, to de-clutter the space and increase the opportunity for student mobility.)

Research Design

To advance contemporary learning space theory, there is a need to move beyond postulation and establish empirically-based causal links between how these spaces translate into improvements in teaching and learning. However, ethical considerations surrounding research in schooling environments rarely support the requisites of a randomised experimental study (Clegg, 2005; Shadish & Cook, 1999). As a consequence, a synthesised quasi-experimental and single subject research design (SSRD) were employed due to its extensive and well-established application in non-randomised intervention studies in the applied and clinical health sciences (Harris et al., 2006; Johnston et al., 1995). This approach was previously successfully implemented by Byers and Imms (2014) and Byers et al. (2014) studies in a similar educational context.

Unlike randomised experimental studies, this synthesised approach placed greater emphasis on the design of the study, rather than statistics alone, to facilitate causal inference (Shadish & Cook, 1999). A key facet of this design was the control of the spuriousness effect/s of confounding variables, to then isolate and measure the effect of a single intervention (Coryn, Schröter, & Hanssen, 2009; Robson, 2011). Rassafiani and Sahaf (2010) and Horner, Swaminathan, and George (2012) have argued that this control improves both within-subject variability and internal validity. As a consequence, these improvements enhanced the rigour and reliability around the claimed causality between the intervention and desired outcomes (Harris et al., 2006; Mitchell & Jolley, 2012; West & Thoemmes, 2010).

The research design of this study sought to control all factors (subject, class construction, assessment and the teacher), except the 'intervention'. The intervention was the shift of each of the classes from their home room GLA (traditional, general learning area) to the NGLS. The research question for the study was to determine if changing the learning space had any effect on students' perceptions of their digital device, learning experiences and levels of engagement in their 'Integrated Studies' subject (English, Humanities and Science through a project-based approach). This question was addressed using a SSRD, which systematically evaluated three research sub-questions (dependent variables):

- What is the effect, if any, of the NGLS on students' perceived value of their digital device as a learning tool?
- What is the effect, if any, of NGLS on student learning experiences?
- What is the effect, if any, of NGLS on student engagement?

A SSRD withdrawal ABA[1] design determined the effect of the intervention – the change in learning space (independent variable) – on students' perceived value of their digital device, learning experiences and levels of engagement (dependent variables). The aim of the withdrawal design was to establish functional relationship between the manipulation of the intervention and the subsequent effect on the dependent variable/s (Horner et al., 2005). Byiers, Reichle, and Symons (2012) and Kinugasa, Cerin, and Hooper (2004) argued that withdrawal studies had a higher degree of experimental and internal validity control than other SSRD approaches. This design enhanced rigour and reliability around the claimed causality between the intervention and changes in the dependent variables.

Methods

The research questions were addressed through an anonymous, repeated measures student attitudinal survey. The survey used three baseline, intervention and withdrawal collection points across three terms. The repeated measures Linking Pedagogy, Technology and Space (LPTS) consisted of 10 items assigned to 3 domains. The LPTS instrument addressed the three research questions – the effect of the learning spaces on students' perceptions of technology (Domain A), their learning experiences (Domain B) and engagement (Domain C). Table 1 shows descriptions and a sample item for each LPTS domain. The items were adapted from elements of the Tamim, Lowerison, Schmid, Bernard, and Abrami (2011) longitudinal study; 'Motivated Strategies for Learning Questionnaire' (MSLQ) (Pintrich & de Groot, 1990); and the earlier Byers et al. (2014) study.

Post-hoc reliability analysis through the calculation of Cronbach's Alpha sought to determine the internal consistency 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 application of this approach resulted in initial Cronbach's Alpha's of 0.70 (Domain A), 0.79 (Domain B) and 0.71 (Domain C) respectively. These values indicate an acceptable level of reliability for the purposes of this study (Gliem & Gliem, 2003).

Sampling

The study's sample was drawn from four primary Year 4 classes. The core curriculum of each class (English, Mathematics, Integrated Studies, Humanities, etc.) was taught by the same teacher. This curriculum was delivered in the same GLA, to classes that

Table 1. Descriptive information for the LPTS survey digital technology questions

LPTS scale	Scale description	Sample item
Perception of Digital Technology (Domain A)	To determine from a student perspective if the use of digital technology is a learning tool that aides and has any positive effect on their learning	Digital Technology has had a positive influence on my learning
Learning Experiences (Domain B)	The extent to which teachers employ those pedagogies that are associated with student-centred learning (i.e., active learning; collaborative/group interaction and learning; independent creativity and personalisation)	My Teacher/s adjust their pace of instruction to respond to students' levels of understanding
Engagement (Domain C)	The extent to which students assess their cognitive and emotional engagement in the context of particular subject/s	This space has allowed me to be in control my own learning

would be best described as 'mixed-ability'. The students within each class were comprised of the full range of cognitive ability.

The sample size (n = 94) was adequate for the desired statistical power (0.8). This sample represented a very high participation rate (95.1%) of the students across the year-level cohort. A priori power analysis for the study's sample size, the probability level of (p = 0.05) and estimated Cohen's d effect size (d = 0.6) meet the requirement of the desired statistical power (Faul, Erdfelder, Lang, & Buchner, 2007). This Cohen's effect size was approximated on the basis of the lower effect sizes calculated during the Byers and Imms (2014) and Byers et al. (2014) studies, which employed a similar survey instrument and methodology. Collectively the participation rate and a priori power analysis meant that the three measures in the baseline, intervention and withdrawal phases were well within the parameters set by Vickers (2003) to ensure the desired statistical power was achieved.

Data Collection

To ensure the a priori statistical power was achieved, the maintenance of a high retention rate was essential. This required the implementation of strategies to deal with missing data from the anonymous repeated measures. Throughout the study a high retention (96.7%) rate was achieved. 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 that resulted in a score greater than 0.05 (0.88). This result enabled a 'missingness' approach to produce a complete data set.

To produce a complete data set the Maximum Likelihood Estimation (ML) approach was employed. The work of Peugh and Enders (2004) has suggested that unlike mean substitution and linear regression, the ML approach would not artificially truncate the variance and covariance around the mean. This truncation would unduly bias the visual analysis process by decreasing the 95% confidence intervals (CI's) (Peugh & Enders, 2004). The effect of decreased confidence intervals would increase the likelihood of Type 1 errors. The ML approach produced a complete data set with the same Little's MCAR coefficient as the initial data collection.

DATA ANALYSIS AND DISCUSSION

The study's a priori statistical power and high participation and retention rates, coupled with the posthoc reliability calculated through Cronbach's Alpha, supported each of the classes being summed and treated as one subject or unit. Even though this was at odds with the argument made by Perone (1999) that "averaging data over many subject can hide a multitude of sins" (p. 112). Due to the large sample size, ethical considerations around an emic research and resulting anonymity of student survey, each class served as their own control and unit of analysis.

The data from the student survey was analysed through a combination of visual analysis and inferential analysis. The visual analysis of class means, with 95% CI's, presented a succinct mechanism to identify inter- and intra-intervention trends (Casey et al., 2012). The visual analysis process employed the simultaneous assessment of level, trend and variability within and across the NGLS and withdrawal interventions (Horner et al., 2012). Bobrovitz and Ottenbacher (1998) have claimed that this process is equitable to earlier *t*-test calculations. The application of confidence intervals as per the research of Baguley (2009), provided a superior approach to single point analysis, as it indicated the plausible range of values that the 'true' effect might take.

Exemplars of the application of this criterion are outlined in Figure 2. Panel A provides an example of a scenario that fulfilled requirements for a statistically significant difference. The non-overlapping CIs between the intervention and withdrawal phases demonstrated an immediate and stable (low variance) change in the mean after the withdrawal compared to relatively stable measures (both in mean and low variance) during the intervention phase. Panel B indicates an instance in which the visual analysis criteria was not met. Panel B shows an example of high variances and unstable trends (in both the intervention and withdrawal phases) and overlapping CIs with means. Collectively this may suggest the influence of confounding or external variable/s, outside the control of the research design.

To mitigate the 'subjective' nature of visual analysis and prevent Type 1 errors, Beeson and Robey (2006) and Kromrey and Foster-Johnson (1996) suggested that quantitative analysis through Cohen's *d* effect size was applicable. The work of Beeson and Robey (2006) suggested that effect size calculations circumvent the
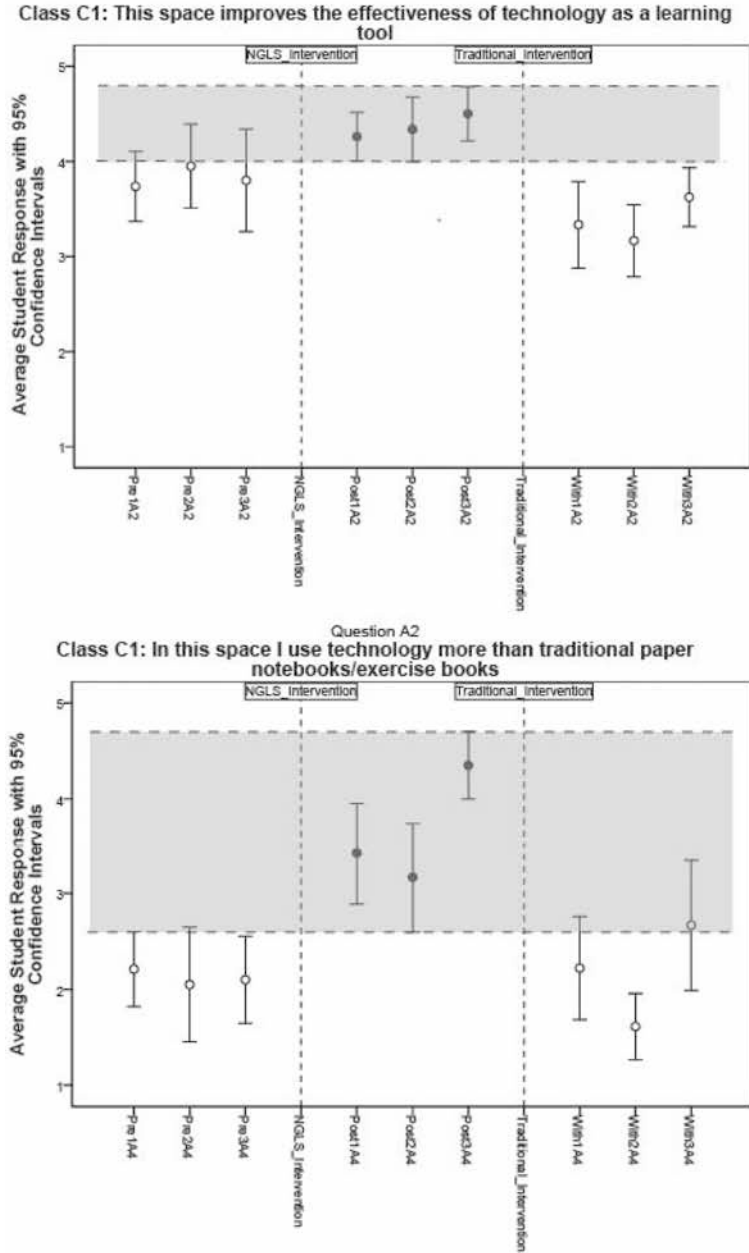
Figure 2. Visual analysis through summative means, with 95% confidence intervals,
demonstrating statistically significant (Panel A) and non-significant (Panel B) differences

distribution issues of auto correlated (as the case of this study), which would be associated with traditional inferential statistics. The thresholds suggested by Cohen (1998) were employed to categorise the degree of the effect size.

The criterion used to determine statistically significant effects were adopted from the Byers et al. (2014) and Byers and Imms (2014) studies. A statistically significant effect required a combination of 'non-overlapping' (NO) confidence intervals (taking into account trend and variability) from the visual analysis and a large effect size ($d \geq 0.8$). The Byers et al. (2014) and Byers and Imms (2014) studies found that an effect size within the large ($0.8 \leq d < 1.3$) range or higher, generally correlated to statistically significant differences observed through the visual analysis process.

This would suggest that statistically significant difference identified through visual analysis is corroborated by an improvement approaching one standard deviation when compared against the baseline/withdrawal data (Jenson, Clark, Kircher, & Kristjansson, 2007).

Effect of the Formal Learning Space on Student Attitudes to Digital Technology

Within this ABA design, the shift from the NGLS (intervention) to the traditional classroom (baseline) resulted in a statistically significant difference in nine out of the sixteen questions (Table 2). All four classes returned a statistically significant difference, supported by large effect sizes ($d \geq 0.8$) and corroborated through visual analysis, for the questions pertaining to the 'positive influence' (A^1) and 'effectiveness' (A^2) of technology. Of note, the effect sizes for the responses to the effectiveness of technology were greater than one, which indicates an overall change in excess of one standard deviation. This would suggest that layout and elements of the NGLS had a significant effect on how teachers incorporated the use of technology within their practice. This then had a corresponding effect on the way students' utilised technology as a learning tool. The correlation between the positive influence and effectiveness responses in this study appeared to provide

Table 2. Summary of the changes in student perception of the effectiveness, relevance and usage of ICT in the mode 3 space compared to mode 1 (withdrawal)

Class	Positive influence (A^1)		Effectiveness (A^2)		Distraction (A^3)		Usage compared to notebooks (A^4)	
	Visual	Cohen d	Visual	Cohen d	Visual	Cohen d	Visual	Cohen d
C1	NO[a]	0.924	NO	1.205	O[b]	0.298	O	1.376
C2	NO	0.867	NO	1.027	O	0.045	O	0.459
C3	NO	0.855	NO	1.589	O	0.354	NO	2.219
C4	NO	0.944	NO	1.027	O	0.049	O	0.752

Note. [a] Non-Overlapping confidence intervals. [b] Overlapping confidence intervals.

211

initial evidence to support the potential of the alignment between affordances of the physical space and technology.

The arrangement of the classroom layout appeared to have little effect on the level of student distraction attributed to their use of technology (A^3). There is research that has suggested that students are distracted by the availability of technology (e.g., Fried, 2008). In this study, students generally responded between 'disagree' to 'unsure' to their perceived level of distraction brought about by access to technology. However, the thought that a more engaging and dynamic space, as opposed to a static and teacher-centric space, would have had a more significant effect on reducing student distraction was not evident in this study.

Effect of the Formal Learning Space on Student Learning Experiences

The shift from the NGLS to the traditional classroom resulted in a statistically significant difference in six out of the sixteen questions (Table 3). All four classes returned non-statistically significant differences in their teacher's practice (B^1 and B^2). The students did indicate that there was some 'improvement' in their teacher's practice (B^1) in the NGLS compared to their homeroom.

This improvement was approximately equivalent to a 'medium' effect. Classes C2, C3 and C4 responded in a similar fashion to the 'personalisation of instruction' (B^2) question. However, Class C1 responded differently, recording a 'large' effect size ($d = 0.910$). However, the variability and trend of the withdrawal period resulted in an overlapping confidence interval. As a consequence, due to the discrepancy between the visual analysis and effect size calculation, this did not meet the criteria for a statistically significant change.

The change from a NGLS to a traditional classroom did result in a statistically significant effect on student learning experiences. For the questions pertaining to increased 'interactivity' (B^3) and 'collaboration' (B^4) between students and teachers, three classes (C1, C2 and C3) returned statistically significant improvement. The correlation between interactivity and collaboration would suggest that these classes were exposed to greater instances of working with their peers through different

Table 3. Summary of the changes in student perception of changes in teachers' practice and student collaboration in the mode 3 space compared to mode 1 (withdrawal)

Class	Improvement in practice (B^1)		Personalisation of instruction (B^2)		Increased interactivity (B^3)		Incidence of collaboration (B^4)	
	Visual	Cohen d	Visual	Cohen d	Visual	Cohen d	Visual	Cohen d
C1	O	0.643	O	0.910	NO	1.295	NO	0.936
C2	O	0.470	O	0.426	NO	0.872	NO	1.007
C3	O	0.676	O	0.700	NO	0.796	NO	1.622
C4	O	0.521	O	0.593	O	0.740	O	0.627

212

groupings in the NGLS. This exposure then increased the interactivity between teachers and students, which would suggest a more dynamic learning setting, when compared against the traditional classroom layout.

Effect of the Formal Learning Space on Students' Perceived Levels of Engagement

The final research question of this study addressed how the change from the NGLS to the traditional classroom affected student engagement in their learning. The combined quantitative approach of visual analysis and Cohen's *d* effect sizes resulted in a statistically significant difference in seven out of the eight questions (Table 4).

Table 4. Summary table of the changes in student perception of changes in their levels of engagement in mode 3 space compared to mode 1 (withdrawal)

Class	Increased interest in learning (C^1)		Preferred space to learn (C^2)	
	Visual analysis	*Cohen's d effect size*	*Visual analysis*	*Cohen's d effect size*
C1	*NO*	1.776	*NO*	2.259
C2	*NO*	1.226	*NO*	1.713
C3	*NO*	1.949	*NO*	1.042
C4	*NO*	1.145	*O*	0.867

All four classes returned a statistically significant difference in how the NGLS influenced their 'interest in learning' (C).[1] Of note, the effect sizes were either large (C2 or C4) or very large (C1 and C3). An exemplar of a very large effect size (*d* = 1.949) that was observed for Class C3 corroborated by visual analysis is provided in Figure 3. The change in level between the NGLS and the traditional classroom during the withdrawal period is both significant and stable.

The change from an NGLS to a traditional classroom had a similar statistically significant effect on where students 'preferred to learn'. The aim of this question (C^2) was to ascertain if the students' emotional engagement was associated with different learning spaces. Three of the classes (C1, C2 and C3) strongly indicated that the NGLS was statistically their preferred space to learn. All three effect sizes were in excess of one, with classes C1 (*d* = 2.259) and C2 (*d* = 1.713) returning a very large effect size. Figure 4 provides a visual representation of Class C2's responses to question C^2 across the baseline/NGLS/withdrawal periods. Of note is the substantially higher and very small variability observed during the NGLS period, compared to the baseline/withdrawal periods. It is hypothesised that if students have a stronger emotional engagement to a particular classroom space that they will have greater interest and intrinsic motivation to learn.
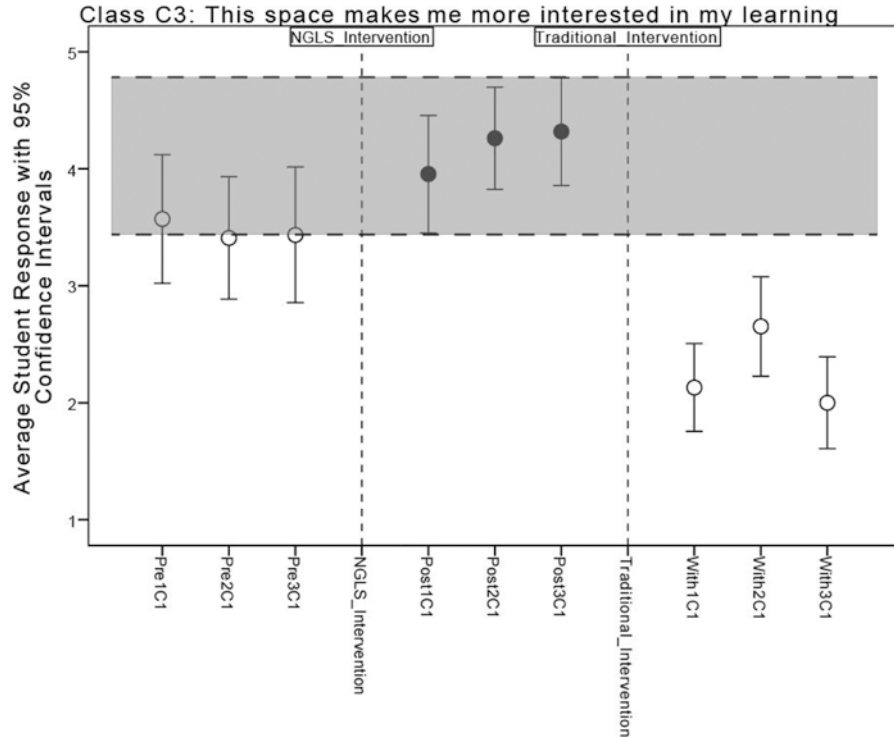
Figure 3. The statistically significant change in C3 class's interest in their learning in the NGLS compared to the traditional (withdrawal) classroom

CONCLUSION

There is growing attention in the literature on the integration and use of digital technology and contemporary learning spaces, and the subsequent effect on teaching and learning. Even though there has been significant funding and human resources directed to these areas, there has been limited empirical evaluation of their collective causal effect on school-age students.

The aim of this study was two-fold. Firstly, it sought to test, refine and validate the methodology of the Byers et al. (2014) and Byers and Imms (2014) studies through its replication in a primary years setting. Secondly, it attempted to build upon limited empirical evidence reported in these earlier studies. The overall aim was to increase knowledge about the causal effect of NGLS on teaching and learning. Collectively this study, along with the notable work of Brooks (2011, 2012), has established valid methods for measuring the impact of learning spaces. In the process, they provide empirical evidence informing discussion about the nature of this impact.
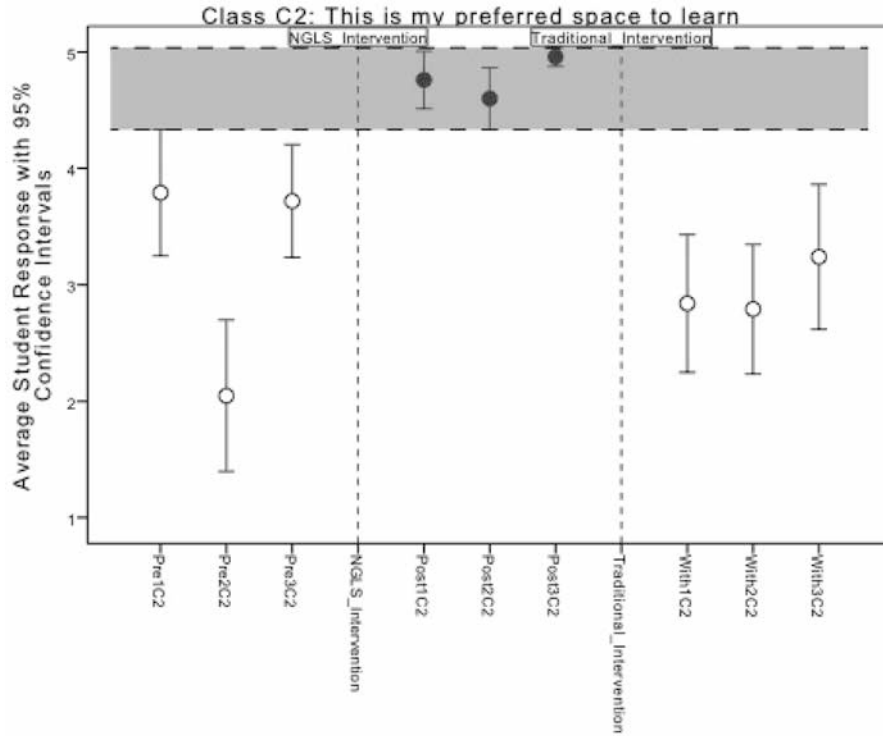
Figure 4. The statistically significant change in C2 class's preferred space to learning in the NGLS compared to the traditional (baseline/withdrawal) classroom

The methodology, a synthesised quasi-experimental and SSRD, has been shown to work in both a primary and middle years settings. This synthesised approach has demonstrated its robustness and reliability through its replication of confounding variable control, instrumentation and data analysis techniques to a different context. This assertion is justified through similar a priori power and Cronbach's alpha analysis and a high retention rate that occurred in the Byers et al. (2014) and Byers and Imms (2014) studies.

The empirical findings presented here have added to the evidence that suggests causal links between NGLS and positive effects on teaching and learning. The analysis of the student surveys across the baseline/intervention/withdrawal periods suggested that alignment between the affordances of digital technology and the physical classroom environment has a positive influence and effectiveness is improved. These findings are comparable to those derived in the Byers and Imms (2014) study. Collectively this quantitative evidence does add weight to assertions

made by Fisher (2010) and Lippman (2010) that 'alignment' between space and technology can result in a positive pedagogical effect.

In terms of pedagogy, the change from traditional to NGLS did have a demonstrable positive effect on perceptions of student learning experiences. The results suggested that the participating students felt they were exposed to more collaborative and interactive learning experiences in the flexible and dynamic NGLS, when compared to the more rigid and static traditional classroom.

This would suggest, as identified in the Byers et al. (2014) study, that when teachers are provided with the affordance of an NGLS, they are often able to create different, and more active, learning experiences for their students. Not surprisingly these different learning experiences in the NGLS had a corresponding and positive effect on student engagement levels.

The move to the NGLS was associated with significant improvements in students' perceived levels of engagement. Students indicated that they were more interested in their learning in a NGLS. Also, that the NGLS was their preferred space to learn. It is hypothesised that these improvements in student 'emotional engagement' in their learning would have an influence on student learning and thereby learning outcomes.

ACKNOWLEDGEMENTS

NOTE

[1]   The *ABA Design* is a three phase *design* consisting of a no-intervention baseline phase (A), an intervention phase (B), and a no-intervention withdrawal phase (A).

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11. AFTERWORD

RECENT SCHOLARLY EVALUATIONS

These ten chapters highlight a significant and focussed effort in evaluating school learning environments over the past five years. In the same time frame a number of additional scholarly examples of learning environment evaluation have emerged in both higher education and K-12 schooling with the researchers using a mixed methods (qualitative/quantitative) approach.

In the higher education sector, Brooks (2012) observed 55 key learning activity factors with 5-minute intervals in active learning spaces. These findings were supplemented by student and staff survey questionnaires, interviews and focus groups which evaluated learning activities, modes of instruction, teacher behaviours, and student behaviours. Brooks found that 'space shapes instructor behaviour and classroom activities'; instructor behaviour and classroom activities shape on-task student behaviour and thus; 'space shapes on-task student behaviour'.

Another higher education study (Scott-Webber, Strickland, & Kapitula, 2013) compared three active classroom layouts (ACL) with a fourth traditional model. Four factors were considered – psychological, socio-cultural, behavioural and holistic, with twelve engagement factors measured. They found that approximately eighty percent of students achieved higher results and that students had better motivation.

In a further study of STEM in higher education (Freeman, Eddya, McDonougha, Smith, Okoroafora, Jordta, & Wenderotha, 2014) evaluated 225 published and unpublished evidence-based articles on teaching STEM in active learning environments. Activities included collaborative problem-solving and personal response systems with studio/workshop pedagogical approaches. In comparing active learning classrooms (ACL's) with lecture modes, the authors found that students taking predominantly lectures were 50% more likely to fail assessment than students taking ACL classes. Concurrently Baepler and Walker (2014) used a flipped classroom model where lectures were viewed online with 30% less staff contact time. These researchers noted that student results were equal or better than the full lecture mode, with higher positive perceptions of the learning experience.

A primarily qualitative study of higher education first year student informal study spaces (Boys, Melhuish, & Wilson, 2014) used a grounded theory method coupled with photo elicitation and observations to determine student preferences for informal learning spaces. This study was developed in view of the rapid emergence of the massive online open courseware programs which are already having an impact

on campus culture and pedagogy. Using ethnographic methods the team obtained 'detailed descriptions of the physical spaces used by the first-year student participants'; made 'observations of different educational settings and their occupation, use, and interactions through written and visual recordings of selected classes in progress'; sought 'student and faculty perceptions and experiences of social and spatial learning relationships through focus group and interview sessions'; reviewed 'individual student volunteers' photo diaries of their learning activities, spaces, and interpretations through a five-day period'; and, finally conducted 'ongoing critical review of the data within the research team, with relevant course teams and campus planners at the university, and more widely through SCUP networks' (p. 10). The authors arrived at a sequence of recommendations regarding planning and design principles to satisfy student requirements when designing informal learning spaces.

Back in the schools sector, Waldrip, Cox, and Yu (2014) tracked four middle-year schools in Australia from their original traditional classrooms practice in 2008 to their new 'open plan classroom' site in 2012 with National testing results showing clear increases in numeracy and literacy. A Personalised Learning Experience Questionnaire (PLEQ) was also used as to measure engagement. It was found that cognition, engagement, self-directed learning, assessment and student well being all improved in the new locations. What is becoming clearly apparent from all of these studies is that there are multiple ways of evaluating new generation learning spaces but, more importantly, that there is no real consensus or agreed framework, classification or taxonomic system for 'labelling' the various aspects that shape learning spaces analysis. The field is quite heterogenous and this points to more consolidated works such as collected in this book being required to overlay the concepts and draw them into a coherent discourse, which is the ultimate goal of LEARN.

LATEST DEVELOPMENTS IN LEARN

Over the period of this book being assembled LEARN has been the recipient of three new Australian Research Council Linkage and Discovery grant funded research projects, a Society of College and University Planning research consultancy, and two large school systems consultancies. These testify to the rapid uptake of interest in evaluation to ensure that new and emerging innovations actually work and that significant capital sums are responsibly invested in new generation learning environments.

These new LEARN studies include:

- ARC Discovery Grant: Mapping complex learning environments. AUD500,000. Universities of Melbourne and Sydney and the University College London.
- ARC Linkage Grant Evaluating 21st Century Learning Environments. AUD550,000. University of Melbourne with seven industry partners including three schools. Commenced Jan 2014 and three doctoral students are half way through their research. www.e21le.com

- ARC Linkage Grant AUD2,000,000. Teacher performance in new generation learning environments. University of Melbourne with 15 industry partners (State Departments of Education, schools, architects and other suppliers) with 6 doctoral students.
- SCUP Perry Chapman Prize. Forecasting the higher education campus of 2025 using expert elicitation. Melbourne University (with University of Sydney and Woos Bagot Architects).
- Department of Education, Victoria. Review of Standard Entitlement Frameworks and site size and outdoor space requirements for schools. This project will propose new area guidelines for the design of schools in the state of Victoria (approximately 3000 schools).
- Catholic Education Melbourne: Towards Effective Learning Environments in Catholic Schools. Evaluation of the alignment between pedagogies and learning environments in a sample of 36 schools in Melbourne to establish performance benchmarks for future schools and future facility upgrades (approximately 350 schools).

At the time of writing LEARN has 12 researchers in the field of evaluating next generation learning environments, and we are very keen to grow the network with other research 'cells' internationally. See www.learnetwork.edu.au

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Neda Abbasi is currently a research fellow in the School of Architecture, Deakin University, Australia. She holds a Master of Architecture from the Faculty of Fine Arts, University of Tehran. Following her Master's thesis titled "The Youth House: a cultural and recreation centre for enriching adolescents' and youth's leisure time" which explored psychosocial needs of adolescents and their preferences for different natural and built environments, she carried out a PhD research in the University of Melbourne between 2006 and 2009.

The research entitled "Pathways to Better Personal and Social Life through Learning Spaces" examined contributions of school design to adolescent identity formation.

Kate Bertram has been a teacher and educational leader in K-12 schools for over 25 years. She has published articles for professional journals and presented at numerous conferences.

The presentations have included research papers, workshops and seminars on the topics of school design, learning environments, leadership, professional teaching standards, teacher accreditation processes and creating learning communities.

Kate's postgraduate studies focused on the areas of museum education, leadership, school design and creating learning cultures. In 2012, she completed a doctorate at the University of Wollongong in the areas of leadership, the theory of learning communities and contemporary school architecture.

Kerry Bissaker is an Associate Professor in Education at Flinders University and Associate Head (International) for the Faculty of Education, Humanities and Law. Prior to her appointment at Flinders University in 1998 she was employed as a classroom teacher and special education consultant. She maintains a strong interest in inclusive education and identifies teachers' learning as being fundamental to successful inclusive education. Her research, and that of her many doctoral students, is on the role of teachers' professional learning in developing schools as highly effective learning organisations in not only Australian schools but developing countries as well. Her research and work in the field of teachers' professional learning both locally and internationally has resulted in ALTC teaching citations, AusAid Australia Awards Fellowships and extensive engagement with the Australian Government's Quality Teacher Project. She works in collaboration with universities, institutes and non-government agencies in Nepal, Indonesia, China and Singapore. Her doctoral research situated at the innovative Australian Science and Mathematics Schools in South Australia generated an explanatory model of professional learning which has subsequently been used as a self-evaluation tool by other schools.

The tool allows schools to reflect on and self-evaluate their own contextual, organisational and relational domains, the affordances already in place that support high quality learning for students and adults and how to generate additional affordances to enhance quality learning outcomes for all. In connection with this current chapter the physical and cultural environment of the ASMS which were reported by teachers as affordances for their professional learning are examined.

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. Concurrently, he is uncovering ground breaking insights into the critical role that the classroom environment plays in this equation.

During this process he has created two observational metric tools, which are now being piloted at several Australian schools. These tools, with the accompanying visualisations, assist teachers to understand how the affordances of different learning spaces and digital technology influences their practices. From this understanding, teachers are then better able to adapt and shape their pedagogical practices to exploit the potential of these affordances.

This focus on empirical evidence has led to the creation of the Churchie Personalised Learning Analytic program. This program synthesise existing academic and student data repositories to predict, advise and intervene in an individual student's learning process and progression. This program has become an essential mechanism in the personalisation of student learning.

Collectively this work has resulted in Terry gaining selection as one of the three University of Melbourne PhD researchers in the 2013–2016 Australian Research Council project 'Evaluating 21st Century Learning Environments'. Recently, Terry has been awarded the prestigious Australian Postgraduate Award and the 2014 Australian Microsoft Expert Educator.

Ben Cleveland completed his PhD 'Engaging spaces: Innovative learning environments, pedagogies and student engagement in the middle years of school' in 2011 in the Faculty of Architecture, Building and Planning at the University of Melbourne. Since then he has worked as Research Fellow with the University's Learning Environments Applied Research Network (LEaRN) – an organization that brings together Australian and international educational bodies, designers, government agencies and professional groups to foster research into the relationships between pedagogy and space in all educational environments.

An ongoing focus of this work has been the development of evaluation strategies that assess the educative value of learning environments. Ben has co-developed and lectures in the Masters electives, 'Innovative Spaces and Pedagogy' and 'Physical Learning Spaces: Effecting Pedagogic Change in Schools' (across the Faculties of Education and Architecture), is Chair Elect for the Victorian Chapter of the Council for Educational Facility Planners International (CEFPI), and consults on a part-

time basis to schools and architects through his business Engaging Spaces. Ben is a former primary and secondary school teacher.

Kim Dovey is Professor of Architecture and Urban Design in the faculty of Architecture, Building and Planning. His research on social issues in architecture and urban design has included investigations of schools, housing, shopping malls, corporate towers, urban waterfronts and the politics of public space.

Books include 'Framing Places: Mediating Power in Built Form' (Routledge, 1999, 2008) 'Fluid City' (Routledge, 2005) and 'Becoming Places' (Routledge, 2009). Current research projects include those on urban place identity, creative clusters, transit-oriented urban design and the morphology of informal settlements.

Raylee Elliott Burns leads the consultancy service *Designing Learning Spaces,* supporting schools and communities in designing spaces for learning and teaching in partnership with accredited architects/designers. Her interest in this field emerges from library designing experiences as a teacher-librarian (1981–1988) and consultant with Brisbane Catholic Education (1988–2000) and as a lecturer, course coordinator and researcher in the Master of Education program at Queensland University of Technology (2001–2011).

Her work with QUT colleagues on a QUT Scholarship in the Professions Grant research project: *Performing hybridity: impacts of new technologies on the roles of teacher-librarians* provided the foundation for the development of a unit of study, *Designing Spaces for Learning*. This Master of Education course-unit is a *place* for educators to question and critique, to research pedagogical impacts of learning space designing and to engage in designing collaborations with colleague educators and accredited designers/architects.

Raylee's cross-disciplinary doctoral project *'Voices of experience' designing the school library: spaces and places for learning (2011)* provides a foundation for continuing research and consultancy.

Kenn Fisher's career has seen him specialising in educational planning in all sectors – schools, vocational and higher education and workplace academies. He balances academic work with consulting in learning spaces, with half time in each sector.

He is an Associate Professor in Learning Environments in the Faculty of Architecture, Building and Planning at The University of Melbourne and has been a Chief and Partner Investigator in approximately $4million of Australian Research Council Linkage, Discovery and Office of Learning and Teaching Research projects in the planning and design of learning environments. He is also co-supervising of a number of doctoral candidates and teaches Master of Architecture subjects in Human Environment Relations and Eduational and Health Planning & Design. Kenn's primary research interests include the evidence based design of learning environments and models of academic professional devlopment for new generation learning environments.

227

Kenn is also a member of the international panel of experts for the Centre for Effective Learning Environments at the OECD (he was Head of CELE in Paris in 1997–1998), as well as having held high level domestic University, Government Educational Ministries and Vocational Education appointments.

Kenn is Director of Education in Woods Bagot acting as an educational planner involved in campus masterplanning, learning environment planning, brief writing and change management strategies. He has consulted widely across the globe including in Australia, China, Malaysia, Thailand, Laos, Cambodia, USA, UK, the UAE, Qatar and New Zealand.

Wesley Imms is a highly credentialed educator with teaching awards spanning his secondary and tertiary teaching career. He is Associate Professor of Education at the University of Melbourne, Australia. Dr Imms' graduate teaching focuses on physical space and pedagogy, innovative pedagogies, arts curriculum, and teacher-as-practitioner issues.

He supervises more than a dozen RHD students with scholarship PhD theses covering topics such as innovative spaces and pedagogy, institutional (museum) education, 'at-risk' student interventions, ESL and social transition, and design education. His research explores issues concerning school learning environment design and use, with a particular interest on the measurement of impact of such spaces on teaching and learning.

Wes is the lead Chief Investigator on the *Evaluating 21st Century Learning Environments* Australian Research Council Linkage project, and the more recent *Innovative Learning Environments and Teacher Change*, and a member of his university's cross-disciplinary *Learning Environments Applied Research Network*.

Thomas Kvan is the former Dean of the Faculty of Architecture, Building and Planning and is Pro Vice Chancellor (Campus Development) at the University of Melbourne, Professor Kvan is internationally recognised for his work in the management of design practice and development of digital applications in design.

During his academic career he has worked at the Universities of Melbourne, Hong Kong and Sydney and is an active researcher and author in design, digital environments and design management. His engagement in the design of campuses for educational and industrial purposes spans forms and technologies, including research into the intersection of Physical and Virtual Learning Spaces. He is currently founding Director of LEaRN, the Learning Environments Applied Research Network, and was founding Director of AURIN, the Australian Urban Research Information Network, hosted at the University of Melbourne that is developing a national digital infrastructure to support urban research.

Tom has practiced architecture in Africa, Europe, Hong Kong and the USA in practices small to large, was director of software development in an IT start-up in California and a management consultant to architects and engineers. He has been a member of the Board of Directors in digital design and facility management

associations worldwide and serves on the boards of several journals and professional organisations. An author of over 140 publications, his latest co-authored book, The Making of Hong Kong (Routledge), explores the volumetric city as a sustainable urban form.

Field Rickards was appointed Dean of the Melbourne Graduate School of Education at The University of Melbourne in August 2004, following four years as an officer of the Academic Board (of which he was President 2003–July 2004). He was appointed to the Foundation Chair in Education of Hearing Impaired Children at The University of Melbourne in 1994 after four years of Reader in charge of the Deafness Studies Unit.

Prior to this, he was Senior Lecturer in Audiology in the Department of Otolaryngology, University of Melbourne, where he established Australia's first post-graduate course in Audiology in 1974. He is a Fellow of the Audiological Society of Australia. His research in the 1980s led to the commercial development of an automatic evoked response audiometer (ASSR) which can accurately measure hearing in infants. The system is manufactured in the US and has been translated into standard international practice as an important tool in the diagnostic assessment of very young infants and children who have failed hearing screens.

His move from audiology to education of the hearing impaired focussed his research on early detection (the Victorian Infant Hearing Screening Program) and early diagnosis of hearing impairment, early intervention (play development and social competence) and factors affecting educational outcomes for the hearing impaired. He has had a close involvement with the Advisory Council of Children with Impaired Hearing, which has run a statewide early intervention program since the early 1970s, and chaired the Victorian State Infant Hearing Working Group. The working group was the major catalyst for the introduction of Universal Newborn Screening in Victoria. He has studied the onset of Otitis Media in Aboriginal Infants in association with the Menzies School for Health Research in Darwin.

Field was a recent co-investigator on the ARC funded Young Learner's Project, a collaboration between the Melbourne Graduate School of Education and the Australian Scholarships Group. The project, which began is 2008, seeks to identify personalised learning strategies for strong literacy outcomes in children in pre-school and the first year of school (4LPO883 437). He was also recently involved in an ARC linkage grant for a longitudinal study of language learning in pre-school children with impaired hearing. With Dr Melissa Wake, he was co-investigator on a large, NIH-funded study of the prevalence, impact and genetics of slight and mild hearing loss.

As Dean, he has guided the transformation of the Faculty of Education to the Melbourne Graduate School of Education on 1 January 2008, and the reform of the professional training of teachers with the introduction of the new clinical Master of Teaching program.

Ken Woodman has practiced architecture in the UK, South Africa, Canada and the USA. For the last two decades he has designed educational buildings in Victoria and New South Wales in Australia and is now the sole director of his own practice, No. 42 Architects.

In 2008 he gained a scholarship to complete a PhD at the University of Melbourne with the Smart Green Schools team. The thesis was titled *Re-Placing Flexibility: An investigation into flexibility in learning spaces and learning*. During this doctorial process Ken studied both architectural and educational philosophers and believes that learning occurs during a transaction between the learner and their learning environment.

Ken is a lecturer at the University of Melbourne in the Masters Subject *Innovative Spaces and Pedagogy*. He has presented at conferences, run professional development workshops, and written academic papers on various aspects of space and learning.