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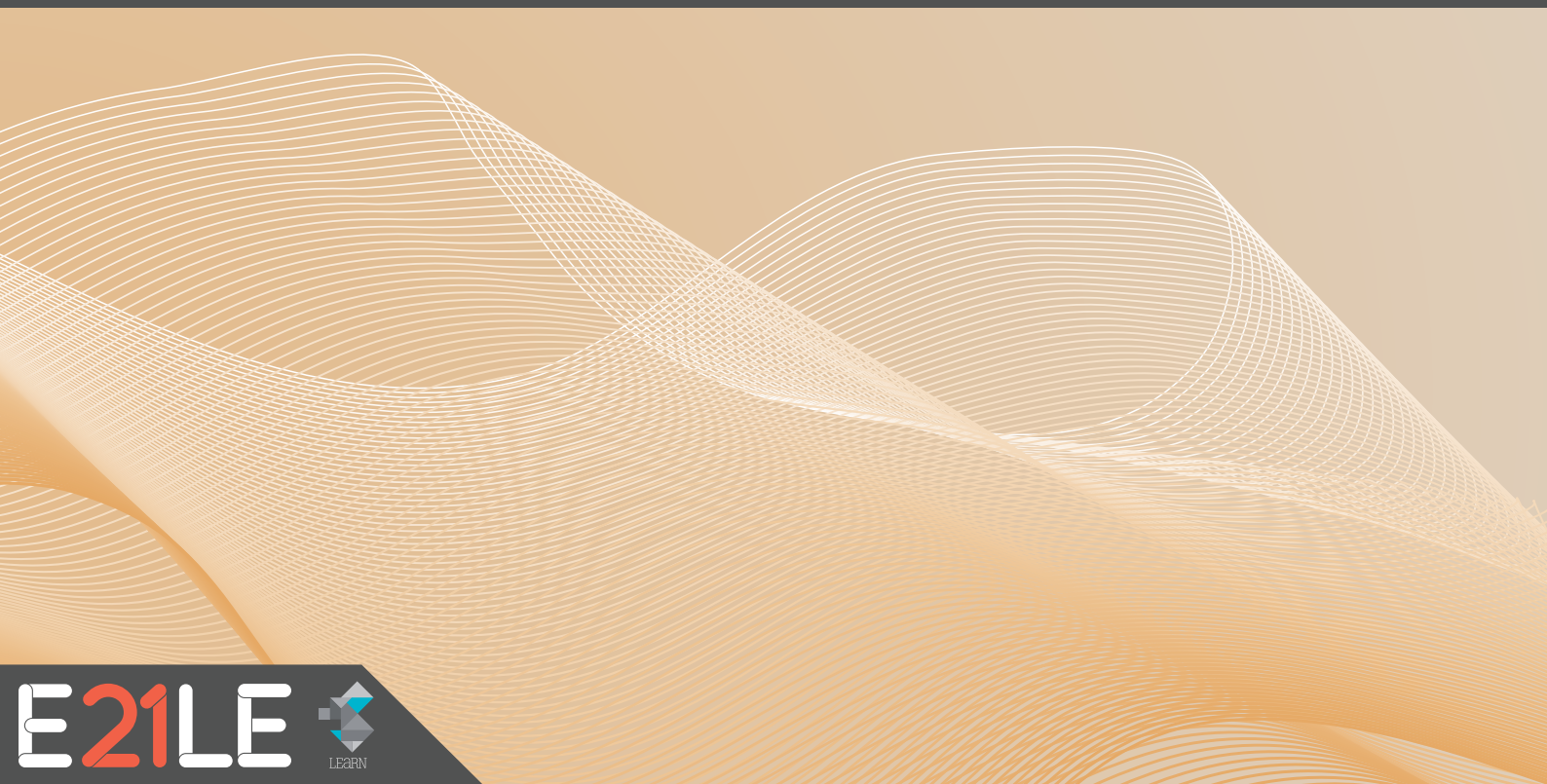# 2015

Mapping learning environment evaluation across the design and education landscape:
Towards the evidence-based design of educational facilities

E21LE

Proceedings

TERRAINS 2015
Mapping learning environment evaluation across the design and education landscape: An international symposium for research higher degree students.

Thursday June 5th, 2015.
Singapore Theatre, Melbourne School of Design, , University of Melbourne.

Hosted by LEaRN

The Learning Environments Applied Research Network (LEaRN) is an initiative of the University of Melbourne's Melbourne School of Design, the Melbourne Graduate School of Education, and the Faculty of Medicine, Dentistry and Health Sciences. It seeks to further quality research into all facets of learning environments, spanning all academic and industry sectors.

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Preface

Tom Kvan
Dean of the Faculty of Architecture,
Building and Planning
The University of Melbourne

On behalf of the three collaborating Schools at the University of Melbourne that are supporters of research into learning environments, the Schools of Design, Education and Medicine, I am very pleased to provide this Preface to the volume of papers presented at the 2015 Terrains symposium.

The symposium was organized by the Australian Research Council funded project, Evaluating 21st Century Learning Environments (E21LE) Linkage Project, and hosted by the University of Melbourne's Learning Environments Applied Research Network (LEaRN).

LEaRN is a remarkable activity. It started off as a network of a few individuals who were interested in the intersections of what it is we do when we are learning, how it is we learn and where it is we learn, examining how these intersect to influence the outcomes. Rather than proceeding blindly to say, 'We know how we teach, we know how we occupy space, we know how you learn, and therefore all three will happen at the same time', we began to think about how we might enhance the outcomes, and the variety of factors that might impact on these outcomes. And for that, we began to look for some evidence.

From this foundation we have developed a number of research projects, of which E21LE is a vibrant example. In this, we are examining critical analysis of the work of designers and teachers who are working closer than ever before to build spaces to meet the needs of 21st century learners, often termed 'new generation learning environments'. We observed that research on these educational spaces highlights that little rigorous assessment of their educative value exists. E21LE is addressing that gap through the development and testing of three complementary multidisciplinary evaluation strategies.

This symposium was one of a series of events on learning environments in a busy calendar of LEaRN events that we hold here at the University, such as Talking Spaces. Terrains is distinctive in that it is a day in which we focus on emerging doctoral research and engage in discussions about the direction and potential of this research into learning environments, including but not limiting the presentations to work emerging from E21LE.

LEaRN is a membership based organization in which the members use the organization to share knowledge, but also to set future research agendas and engage in interdisciplinary and collaborative learning environments research. This has contributed to LEaRN's very broad research domain – it extends from the affordances of hospital corridors for medical education delivery through to classrooms and school playgrounds.

The impact of LEaRN over the years has been profound. It has contributed significantly to the redesign of physical spaces from schools to universities, not just in Australia, but abroad. For example, earlier this week, we had a meeting with a presentation online from the Karolinska Institute in Stockholm who attributed significant aspects of change in that institution to what they had picked up here in Melbourne through their membership in the LEaRN network.

It is with great pleasure that we hosted Terrains and are able here to present papers based on the work discussed at that symposium.

About Terrains

The disciplines of architecture and education are witnessing a burgeoning interest in designing learning environments for contemporary education. There is growing evidence that designers and teachers are working closer than ever before to build spaces to meet the needs of 21st century learners.

But are these spaces working as intended? It is argued that the complex nature of schools and schooling hinders such assessment. However, the 2014 Snapshots symposium demonstrated that the rich tapestry of educational circumstances evident in schools does not preclude quality evaluation of learning environments. Snapshots identified the key issues, methods and knowledge now emerging in learning environments evaluation.

To progress this discussion to its next logical level, partners supporting the Australian Research Council's Evaluating 21st Century Learning Environments Linkage Project, in association with the University of Melbourne's Learning Environments Applied Research Network, invited current and recent research higher degree students (RHD) to submit papers for the 2015 Terrains International RHD Symposium.

Symposium theme

Terrains, as its name suggested, was a cartographic examination of learning environment evaluation. It invited all higher-degree students working in learning environments to assemble and present a short synopsis of their research. Through the careful sequencing of papers, and input after each paper by expert interlocoteurs, Terrains explored how this research addressed evaluation of

such spaces, and how this constituted a map of current thinking in learning environment evaluation. As such, Terrains was a working symposium, with new knowledge being generated from the exchange of ideas occurring around each presentation.

Terrains was designed to allow currently research to be presented and interrogated around the symposium's central theme. For this reason, the focus of abstracts was quite divergent, including:
- The conceptualizing and designing of learning spaces for future learners;
- Relationships between learning spaces and pedagogy;
- The technical performance of educational facilities;
- Evidence-based design of educational facilities;
- Learning spaces as catalysts for change;
- The inhabitation of new learning spaces;
- Evaluating learning spaces.
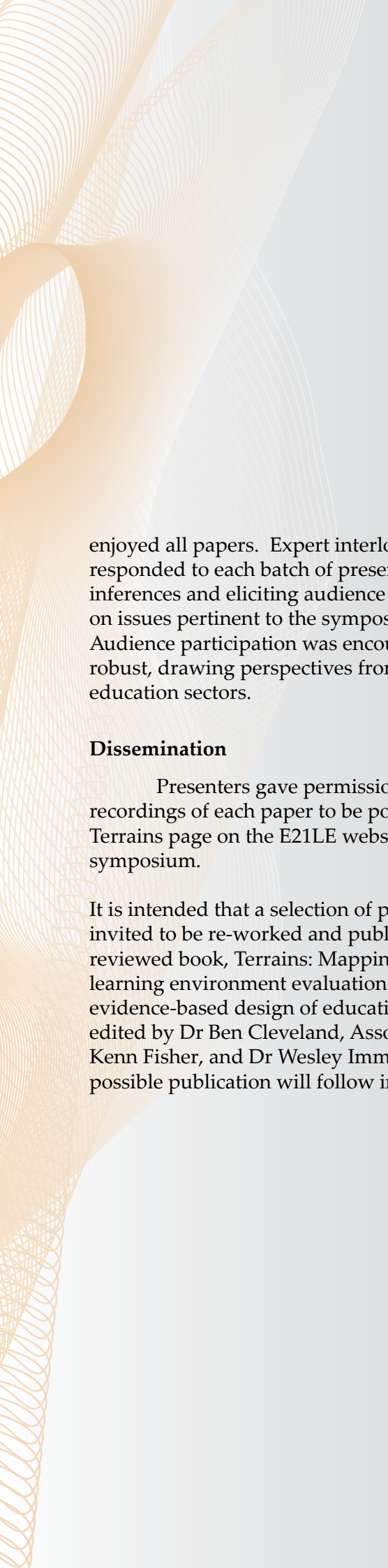
Terrains treated these papers as springboards towards a more focused examination of what evaluation methods are most urgently required by the field.

Symposium details

Terrains was situated in the Melbourne School of Design's Singapore Theatre. Presenters were given 10 minutes to discuss their paper, matched then to 10 minutes of feedback and discussion. Paper were given in batches of three across one day beginning at 9am and concluding at 5.30pm. The day was an intense and highly informative interchange of ideas.

There was no concurrent sessions – all participants

enjoyed all papers. Expert interlocoueurs responded to each batch of presentations, drawing inferences and eliciting audience discussion on issues pertinent to the symposium theme. Audience participation was encouraged and robust, drawing perspectives from the design and education sectors.

Dissemination

Presenters gave permission for video recordings of each paper to be posted to the Terrains page on the E21LE website following the symposium.

It is intended that a selection of papers would be invited to be re-worked and published in a peer-reviewed book, Terrains: Mapping approaches to learning environment evaluation. Towards the evidence-based design of educational facilities, edited by Dr Ben Cleveland, Associate Professor Kenn Fisher, and Dr Wesley Imms. Details of this possible publication will follow in due course.

Interlocutors

Clare Newton is an Associate Professor in Learning Environments in the Faculty of Architecture, Building and Planning at the University of Melbourne. Clare is an architect and teaches and researches in the fields of design and construction. She was first-named Chief Investigator on two Australian Research Council Linkage Projects and a Chief Investigator on two further ARC projects. She is currently part of a research collaboration between academics and industry called Transforming Housing, which is focused on strategies for affordable medium-density housing. She has received multiple learning and teaching innovation grants. Her most recent innovation grant enabled a 'flipped classroom' strategy for six hundred first-year students.

Peter Jamieson is an Educator with wide experience in teaching, course design and educational development in the School, TAFE and University sectors. He is regarded nationally and internationally as a leader in Learning Environment Design. He has undertaken projects in a large number of universities, schools and other educational providers in Australia, New Zealand, Hong Kong, Sweden, England, Scotland, Ireland, Wales, New Zealand, Canada and the USA.

Julia Atkin is an independent education and learning consultant who works across education settings in Australia and internationally. Julia's professional services focus on transforming all facets of education from the industrial era to the knowledge era and the learning demands of 21C. With over 25 years of experience in this endeavour Julia has worked with educators, designers and architects across early childhood to tertiary settings to provide educational services, systems and both physical and social learning environments.

Julia's awards include Apple Distinguished Educator, 2000-2004, Fellow of the Australian College of Educators, and the Sir Harold Wyndham Medal-2000 in recognition of the contribution her work has made to the learning of teachers and the children of Australia.

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Opening address

Professor John Hattie
Director, Melbourne Education Research Institute

The convenors' wish to express their appreciation to Professor Hattie for presenting the Opening Address at Terrains, and for giving permission for this edited transcript to be published. Transcripts of speech vary enormously from academic writing, but often carry an immediacy and poignancy that should be shared; thus this edited transcript. Professor Hattie's comments galvanized much debate during Terrains, and we appreciate his generosity in allowing this transcript to be published.

Thank you for inviting me to open *Terrains*. I do like its sub-title, "Towards the evidence based design of education facilities"; I appreciate evidence. I've looked at the Visible Learning research findings from about twelve hundred meta analyses involving about a quarter of a million students, with findings showing an average effect size of .4. We are finishing a similar study looking at learning strategies involving a sample of about twenty million students. I'm now working with a group in Germany looking at emotional and motivational outcomes. The first point, is that we claim to be an evidence based profession – but let's move forward and now use this evidence.

What this experience shows me is that evidence is a contested notion. For example, politicians have their interpretation of evidence; what the voter thinks. It's interesting that politicians and many policy people speak 'evidence-based' but theirs is perhaps more about appeasing the voter and parents, even if it's contradictory to what we as researchers and teachers think is the interpretation of that evidence. Another example is that teachers have their own source of evidence - their twenty years in classrooms constitutes evidence, it's no surprise that they privilege that over what we

see as evidence. So, one of my challenges to you this morning, particularly a group like this, is to ask what you as teachers (especially when you speak to politicians and policy people) mean by evidence? And I hope that you will think of how you can convert your evidence to policy. This is because you in the architecture industry have the luxury that many of us in education do not have; the results of your evidence can actually be seen! In education the things that often make the difference is expertise you cannot see, but you can see a new building, you can see a new school.

And so to the title. What are the effects from changing architecture in a school from the traditional egg crate model to the kind of spaces that I know many of you invested in? My evidence says the effect size of doing this is as close to zero as you can get. It doesn't make any difference! And what's worse is that most of the teachers that do convert to a different architectural space were most likely already those who were successful in the egg crate model. Let me outline a parallel case. My pet hate topic is class size, there has been hundreds of studies, hundreds of thousands of students, tens of thousands of teachers that have been contrasted in class sizes of twenty five to thirty compared to fifteen to twenty. We don't need to another study to realise that class size effect on learning, across the many dimensions of learning, is no different to changing architecture - close to zero. That upsets people dramatically because they believe it should; but 'it should', is not the same as 'it is'. Of course it should. So the big question is why doesn't it matter?

Why do you think it makes virtually no difference when a teacher moves from a class size of thirty

to a class size of fifteen? The major reason is that when teachers are moved from larger to smaller classes, they do not change how they teach; *they carry on with what they did before.*

Most teachers in a class size of twenty or thirty have a 'stand and deliver', a 'tell and practice' approach. It's the Kath and Kim "look at me, look at me" model. . Teachers in this model ask on average between 150 and 250 questions a day. Ten percent of them ask 150 to 250 questions an hour. Ninety percent of their feedback (written or verbal) is about the content. That's the standard model and it has worked in classes of 25-30. What is fascinating is that when we put teachers in class sizes of fifteen to twenty they talk more, they ask more questions, they have fewer group tasks, they give less feedback because they're doing what they were doing in a larger class size. It is a similar explanation for why there is no effect (on average) from changing the architecture. If you take teachers out of their egg crates and put them into fascinating and innovative designs, they teach the same way; it makes no difference.

So the plea that I challenge you with today is "… how do you change the teaching to optimize the power of architectural difference?" Where is the book on how to teach in an open plan classroom, a flexible learning environment? If you don't do this, the design is going to be wasted. Teachers are incredibly good at using book cases, filing cabinets, and pot plants to re-create egg crates, but what a missed opportunity! There needs to be constructive alignment between the methods of the teacher and the opportunities and potential offered by these new spaces. Bring on the marriage!

I've gone around the world, into many classrooms, and there is some stunning teaching and exciting learning and dramatically different educational experiences happening because it's not in an egg crate. Stonefields in New Zealand is one such school (http://www.stonefields.school.nz/). I've watched its development from day one, and would claim it is probably one of the most exciting schools in the world. My son recently turned down an appointment to Stonefields, I was disappointed, but it was because he wanted to go to another school that was brand new and aiming to emulate what Stonefields are doing. I admire that he has taken on this challenge; he wants to know how he can teach more effectively and not become an expert in the egg crate model.

So how do we get to this wedding between the different kinds of architecture that I know are dear to your hearts, and the different kind of teaching that's needed to really make a difference? That is the challenge I put to you, because I see some impressive school architecture that's being absolutely misused - a wasted resource. For me it is a causal thing; you start with the teaching, you train people how to teach differently, and then move into the new spaces. A key ingredient relates to the most exciting change in schools that is starting to occur, which is the notion of collaborative planning, teaching and evaluation - collective impact is happening! The notion of an individual teacher with a class of students for a whole year where they go in and close the door, pull up the bridge over the moat - those days need to be over. This is not the world we live in anymore; to get teachers to collaborate, we need spaces for them to collaborate. That's what I see at schools like Stonefields.

I note the range and depth of people here today. I also want to acknowledge those making a difference. I recognise Brisbane's Churchie, as we in MSGE were delighted last year to award Churchie an award for one of the best research collaborations with LEaRN academics in our Faculty last year. I encourage you to enjoy your day, which is surely a given, but also ask you not only to talk amongst yourselves but think about talking about the people that are not here and make them aware of what is happening in this new marriage. You are at the forefront of what's going to make the difference, provided you can make that wedding happen. So enjoy Terrains.

Beyond the bounded notion of the classroom: A theoretical orientation for evaluating the geographies of New Generation Learning Environments

Sarah M. Healy, Gina L. Grant, Ethel D. Villafranca and Pamela Y. Yang
The University of Melbourne

Leander, Phillips and Taylor's (2010) critique of the bounded notion of the classroom is our point of departure for investigating how learning contained within a static conceptual space limits understandings of the geographies of learning. We reframe the traditional perceptions of the classroom as a container to make explicit the multi-dimensional nature of learning environments. The nested, intersecting, and overlapping characteristics of these spaces are reflected in our individual research approaches. Although the studies conducted by each author will follow a unique trajectory, the evaluation of effective learning spaces is a common and critical anchor allowing us to navigate new conceptions of spatial practice. One researcher maps student perceptions of how the learning environment impacts engagement. The second researcher investigates how teachers inhabit the physical space and negotiate the pedagogy within and around it. The third researcher considers the possibilities of learning that can occur outside schools, with a particular focus on museums. The final researcher looks at the 'unknown' space where the virtual blends with the actual. These approaches serve the purpose of highlighting the extraordinary terrain across which learning environment evaluations are situated.

Sarah Healy

Sarah Healy is a graduate researcher at the Melbourne Graduate School of Education, the University of Melbourne. Her research interests include learning environments, art education, and youth participatory methodologies. Sarah has a background in the creative industries and is a registered secondary school teacher. She is a PhD candidate and current recipient of an Australian Postgraduate Award.

Gina Grant

Gina Grant is a Doctoral candidate at the Melbourne Graduate School of Education, the University of Melbourne. After working as a visual art educator in both government and independent primary schools, she returned to university to work in Arts Education whilst completing her Master's Degree in Education. During this time she also monitored teacher candidates in their placement schools and gradually developed an interest in how teachers negotiate new learning spaces.

Ethel Villafranca

Ethel Villafranca is a PhD candidate at the Melbourne Graduate School of Education, the University of Melbourne. Currently a recipient of the Melbourne International Research Scholarship, her research interests include museum education, visitor studies and evaluation, and audience development. She completed her master's in Museology, on a Fulbright Scholarship, at the University of Florida and her bachelor's in Philippine Arts (major arts management), at the University of the Philippines. Ethel has been involved in various aspects of museum/cultural work in the Philippines and the USA
since 1998.

Pamela Yang

Pamela Yang is a graduate researcher and recipient of the Melbourne Research Scholarship at the Melbourne Graduate School of Education, the University of Melbourne. Her research interests are in blended learning environments, learning design evaluation, and mixed method methodologies. Pamela is a registered secondary school teacher and has experience in teaching both language arts and music performance.

This paper by four commencing doctoral researchers is concerned with developing a theoretical orientation that may be applied to future research considering both the geographies and effectiveness of new generation learning environments. By adopting an explicit socio-spatial perspective we hope to transcend metaphors of space such as 'geographies of learning environments' or indeed 'Terrains: Mapping learning environment evaluation across the design and education landscape'. We use Leander, Phillips, Taylor, Nespor, and Lewis' (2010) critique of the "classroom-as-container" (p. 329) to open dialogues about how each of the four authors' unique yet intersecting research trajectories might coevally move beyond the bounded notion of the classroom. In so doing we draw links with what this may mean for us in conducting research that in-part seeks to evaluate learning spaces across multiple terrains.

Lefebvre (1991) notes that space is not neutral, objective or innocent. Therefore it is important to bring a spatial consciousness to our imagined geographies in order to grasp the more evasive aspects of space, to make the unseen, seen. Leander et al (2010) employ Lefebvre's analysis of a house to challenge assumptions held about space. The Lefebvrean house is first considered in terms of its physical structure: solid concrete walls, immobile, and stable. Then we are shown how stripping the house of its walls would reveal energies such as the internet, television, gas, and electricity flowing in and out, transforming the house into what Lefebvre describes as "an image of complex mobilities, a nexus of in and out conduits" (as cited by Leander et al., 2010, p. 332). Leander et al then draw a parallel analysis of the classroom as "the epitome of immobility" (Leander et al., 2010, p. 332) bounded and contained by conventions such as material structure, teaching practice, parental expectations, timetables, seating plans, and daily routines. They ask how the classroom-as-container may be reimagined if it were stripped of its metaphorical walls, destroying its solid appearance. This raises the question of how this may affect our own approaches to research. How do we see the unseen? Hear the unheard? Develop a sonar system to help navigate the diverse geographies of new learning environments?

We begin by embracing an open, fluid, dynamic, lively view of learning environments, seeing them simultaneously as the social, material, conceptual, temporal, and virtual spaces of learning. This view of learning environments is underpinned by our understandings of space itself: an illusive theoretical concept, evading simple, singular, or fixed definitions. Hence, rather than defining space, we present the following ontology informed by the theories of Lefebvre (1991), Massey (2005), and Soja (2014):

- Space is interrelational (Lefebvre, 1991). The social, material, conceptual, temporal, virtual, corporeal, epistemological, and performative aspects of space are interrelated – or entangled if you like.
- Space is a sphere of multiplicity, coexisting het-erogeneity, and coeval trajectories (Massey, 2005, p. 9).
- Space is "a product of a mutually formative socio-spatial interaction" (Soja, 2014, p. 13), a socio-spatial dialectic (Soja, 2014, p. 173), and as such is constantly under re-construction and subject to change (Massey, 2005, p. 9).
- Space is multi-dimensional and simultaneous-ly encompasses the "real-and-imagined" (Soja, 2014, p. 177), the social and material.
- Space is not fully knowable: "There is always something that is hidden, beyond any analytical point of view, shrouded in impenetrable mys-tery" (Soja, 2014, p.177).

With this positioning we do not intend to create an open space/enclosed space dichotomy. Instead we understand the contained and uncontained as folding and collapsing into each other allowing for coexisting heterogeneous spaces. This ontology of space grounds the individual research trajectories of each author. We now turn our attention to these four studies: engaging spaces, inhabiting spaces, expanding spaces, and unbundling spaces. Although conceived separately, and dealing with unique research issues, there is a commonality in our efforts to identify and evaluate affective and/or effective learning spaces.

Research trajectory one: engaging spaces - Sarah Healy

My study seeks to reterritorialise the geographies of student engagement by collaborating with young people as researchers in an investigation into real and imagined spaces of engagement. An aim is to support the expansion of young researchers' own socio-spatial awareness through photographic explorations of their perceived, conceived, and lived experiences (Lefebvre, 1991) of engaging spaces. It is anticipated this youth participatory approach will enable an unbinding of established spatial imaginations and a blurring of boundaries

constructed by the class-room-as-container discourse.

Young people can be seen as experts in their own realm. Their perspectives are important because they offer unique insights that adult researchers might find obscured or beyond the horizon. However, as Thomson (2008) points out, youth participatory approaches to research are associated with complex notions of student voice, or, a nexus of voices. Young people speak from multiple vantage points with multiple, contradictory, and coexisting voices. In addition, each individual can be seen to have a number of ever changing voices with which s/he may choose to speak. One is the "schooled voice" (Thomson, 2008, p. 5). I would argue bounded notions of educational space, such as the classroom-as-container, are manifested through a young person's schooled voice.

The methodological issue this brings up is how to frame youth participatory research so that it may realise the ideal of dissolving the walls of the house, classroom, or school rather than perpetuating existing frames of reference. Burke (2008) argues that explicitly adopting a critical framework that questions assumptions held by, and about, both adults and young people lays the foundations for richer youth participatory research outcomes. Building on this I propose that clearly adopting a critical socio-spatial perspective for my research will help raise students' agency in their choice of voice with which to speak about space.

Critical use of visual research methods may also assist in creating possibilities for young people to speak with a less bounded and 'unschooled voice'. For example, in a reflection on her Play in Focus study, Burke (2008) found that "enabling the visual voice of the child to articulate and define their spaces for play revealed much that countered prevailing notions held by adults about children's preoccupations" (Bourke, 2008, p. 33). This suggests that enabling young people to articulate and define their spaces of engagement through a photographic voice may also unveil aspects of spatial practices of engagement previously unnoticed by adult researchers.

Burke (2008) also notes that a "photograph's narrative becomes itself a participatory site for wider story-telling" (Bourke, 2008,p. 34). In this sense photographs by young people can be seen to have the potential to convey voices within voices and spaces within spaces. This allows for complex, multi-layered interpretations and analysis that

have the potential to socially and spatially inform our emerging understandings of the dialectical relationships between student engagement and learning spaces. So, what will be the impact of this research? It is anticipated that ultimately it will add a valuable student perspective to the development of frameworks for evaluating student learning environments and student engagement.

Research trajectory two: inhabiting spaces - Gina Grant

This study proposes to investigate the position of the teacher within the learning environment. The traditional consideration of the classroom as being a container, where learning occurs at a particular period of time, in a particular mode, within a particular space, is one that most people accept without question, as it is the one that they have most likely experienced (Leander et al., 2010). Within this static structure, the teacher is seen as the transmitter of information. This dominant discourse of what a classroom was, and therefore what it should be, has created a barrier to open discussion regarding what a classroom may be.

When we go into schools, what is it that we expect to see? Hopefully we shall see a place that is full of a variety of activities with both students and teachers interacting, as teaching and learning are not static behaviours but are responses to a variety of social and material stimuli. In classrooms, learning activities occur as individual, small group, or whole class interactions. Watch an experienced teacher during the usual daily classroom interactions, and you may notice that, not only does s/he move through the space, making sure that materials are available when necessary, s/he also manipulates the environment in order to elicit particular responses from students and then uses these as feedback for reflection on their own practice.

This, however, is not empirical evidence. The teacher may be replicating the practice of peers, or of their previous teachers. They may also be unable to articulate the reasons for decisions made regarding the use of space. We are unable to make generalizable connections between intent, action and outcome without analysis. Though links between the use of space and student outcomes have been made (Blackmore, Bateman, O'Mara, Loughlin, & Aranda, 2011; DEECD, 2008) there is little rigorous investigation into of the nature of the relationship between pedagogy and the physical environment.

Whilst discussion regarding space has increased in intensity, especially as federal and state authorities finance the building of new schools, hoping to achieve 'better' outcomes for the nation's students, the notion of the lineal 'space' of school timetables is one aspect of teaching that has not yet been fully appreciated. The authority of the timetable may override both pedagogical intent and the trajectory of learning, distorting the potential transformative nature of spatial change.

In order to develop a clearer view as to how teacher pedagogical practice and other organisational structures influence the new learning environments, I plan to investigate the environmental competencies (Lackney, 2008) of teachers, evaluating their use of these spaces. Such an investigation is required to encourage teachers to re-imagine both their expectations of how a classroom operates, and their pedagogical practice. In order for teachers to utilise the new environments successfully, they require empirical evidence that these spaces are effective for both teaching and learning. Without this evidence, there is a danger that they will embrace the classroom-as-container ethos, no matter the physical design.

Research trajectory three: expanding spaces - Ethel Villafranca

Taking students out of school and into informal learning environments, such as museums, zoos, aquaria, botanical gardens, and even theme parks, is an attempt at disrupting the classroom-as-container practice. However, educators carry their 'imagined classroom' on their back. They treat these out-of-school spaces as extensions of their classroom by behaving the same way, using the same classroom management, and employing the same teaching practices, schedule, and routine (Leander et al., 2010). Yet having an 'imagined geography' and a preconceived expectation on 'when' and 'where' learning takes place limits educators' capacity to fully understand various ways learning happens, diminishing the educative value and potential of these alternative learning environments.

Museums are popular destinations for school field trips. That students learn in museums has been strongly established (Falk & Dierking, 1995, 1997; Hirzy, 1996; Hooper-Greenhill et al., 2006; McComas, 2006). Hooper-Greenhill (1991) notes an awareness among educators that museums should offer experiences that are different but complementary to the classroom. Hein and Alexander (1998) underscore "the power of museums to provide contexts for connections" (Hein & Alexander, 1998, p. 129) and help visitors arrive at that 'eureka' moment. Museums facilitate expansion of visitors' worldviews by providing connections to disparate facts, ideas, and feelings (Falk, Dierking, & Holland, 1995). However, Lord (2007) asserts the value of the museum experience lies in its affective and transformative quality as this may result in a change in visitors' attitudes, interests, appreciation, and beliefs.

The research focuses on evaluating effectiveness of university museums as a learning environment for tertiary level students. It will initially involve mapping out current student engagement levels and activities of university museums. My interest in this topic stems from my belief that university museums are in a strong position to create significant impact on student learning but are, unfortunately, underutilised as a valuable and readily available resource. University museums must take an active role in engaging students to expand their archaic function as repository of precious objects. I propose that resources be employed to remove barriers that restrain university museums from maximizing their potential as effective learning spaces.

The educative value of museums is traditionally evaluated through an assessment of their exhibitions and programs. Falk and Dierking (1992, 2013) advocate that the museum experience involves the interplay of three distinct contexts: decisions visitors make are "filtered through the personal context, mediated by the sociocultural context, and embedded within the physical context" (Falk & Dierking, 2013, p.30). They further add that the museum experience is gestalt and it starts with deciding to visit, going to the museum, viewing the galleries, conversing with people, eating, to purchasing items from the shop. This extends to post-visit discussions and when memories are triggered by certain words, images, events, or objects.

In light of this gestalt notion of the museum experience, I would like to explore the possibility of evaluating how the museum's built environment facilitates learning beyond exhibitions and education programs. By drawing from both fields of museology and architecture, this study hopes to contribute to the reimagining of the space where learning in university museums happens to encompass areas beyond the galleries, lecture halls, and activity rooms. Considering the inherent nature of museums as an educational institution,

albeit an informal one, would it be possible to evaluate these in the same way that innovative learning spaces are assessed? What qualities of innovative and effective learning spaces can be adapted by university museums to make them more effective without losing its identity as a unique space for learning?

Research trajectory four: unbundling spaces - Pamela Yang

Research in understanding learning has always involved a notion of 'where' and 'when' learning is happening. In this paper we remap the traditional notion of a contained and 'immobile' classroom into a learning space that is multidisciplinary, dynamic, and expansive enough to fill the geographies and mobilities of learners today. This study moves away from a discussion of the construction and reconstruction of physical places to the formation of new virtual places, where arguments are made that such 'cyberplaces' are spaceless and placeless, nowhere and everywhere in nature (Kitchin, 1998).

According to Griffin, McGaw, and Care (2012), we are experiencing economic shifts on a global scale. Major shifts, along with the proliferation of the internet, changed people's ways of thinking, living and working. Hence another set of skills on fostering generativity and creativity is needed to intersect the negotiation of social 'space' between physical and virtual places in life trajectories.

In addition, rapid technological innovation has facilitated an explosion of tools and media for learning in virtual spaces. Institutions continuously update their information technology infrastructures to accommodate learning that is not restricted to just one space and time. One mission of education today is to navigate these innovative spaces to help learners develop 21st century skills, including collaboration, creativity, communication and critical thinking (Griffin et al., 2012, p. 7).

Globally, there is competition and demand for innovative models of education. MOOCs have surfaced as one of the highest profile examples of a competing system. Purely virtual, this model of online learning disrupts geographic and economic barriers, challenging traditional notions of space and time. However, as low-completion rates and difficulties in assessing learning outcomes impede its widespread adoption across institutions, educators look to blended learning models for its transformational potential.

Blended learning is both simple and complex, and may be seen as 'best of both worlds'. At its simplest, blended learning is an area of design and inquiry that combines face-to-face and online modalities (Bonk & Graham, 2006). As the scope of blended learning increases and the related research matures, more and more diverse voices have entered the conversation in attempt to define the field (Bonk & Graham, 2006; Wang, Fong, & Kwan, 2010). However, evidence still shows a lack of theoretical coherence among blended learning research, due in part to blended learning being a relatively new area of inquiry (Drysdale, Graham, Spring, & Halverson, 2013). Nonetheless, according to the NMC Horizon Report (2015) conducted by the University of Central Florida, blended approaches were most successful in 'unbundling' the classroom. It reported students felt online tools made instructors and content more accessible, but altogether, having been able to verbally converse ideas was what reinforced student motivation.

Despite blended learning having received recognition for its transformative potential in education (Dziuban, Moskal, & Hartman, 2005; Garrison & Kanuka, 2004; Graham & Robison, 2007), there is a need for more empirical and evaluative research to back up these optimistic claims. Researchers are still early in the development of sustainable assessment tools for blended learning environments to measure clarity, authenticity, unity, suspense (provoking learning motivation), depth, precision, sensitivity, proportion and overall flow in learning (Graham, Woodfield, & Harrison, in press).

Entering an exciting era for education, we are constantly experimenting with space and creating new opportunities to learn. However, in order to meet the demands of the 21st century, there is also critical need to introduce breakthroughs in evaluative methods that include elements that are informative, interactive, internet-based, interventionist, and provide instant feedback. Within this context, an argument can be made about mapping the new mobilities in learning, and that is: it is not bounded and will not hold still (Leander et al., 2010).

Conclusion

This paper set out to develop a theoretical orientation that would inform each author's individual research trajectory. In the process it became apparent that educational research spaces could be seen as bounded and contained - much like classrooms. The studies themselves are bounded by their specific aims, intended outcomes, and our conceptions of what 'good' doctoral research looks like. Hence, we recognise the importance of not only seeking to reimagine the geographies of learning but also mapping this onto a reimaging of the geographies of educational research. By doing this, Leander et al. argue, we may "push open the boundaries of the enclosed classroom as dominant discourse and historically sedimented geography within educational research" (Leander et al., 2010, p. 330). The result is four heterogeneous research directions that seek to disrupt the bounded notion of the classroom while developing research practices that enable reconceptualisations of learning environment discourse. Collectively these nested and intersecting trajectories are a response to the immanent need for theoretically grounded research that will develop theory and practice in the emerging field of learning environment evaluation.

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Are your school interiors giving you a pedagogical edge?

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This paper examines what inflence the interior design of primary school learning environments has on creating pedagogical advantage. Contemporary Australian education culture is characterised by a shift away from a teacher-centred transmission of information towards child-centred co-construction of knowledge, skills and understanding (Burke, 2013; Department of Education and Early Childhood Development [DEECD], 2008; Edwards, Gandini & Forman, 2012). New school interior design patterns including entry galleries, learning streets and indoor courtyards are being developed as venues for learning (Dudek, 2015; Taylor, 2009). But how do these interior environments function, and how effective are they at promoting a culture of collaborative learning?

Drawing on case study research conducted in two schools in Victoria, Australia, this paper outlines a research methodology for assessing the role of interior design in supporting and facilitating cultural change (Stake, 2010). This research reveals that the closer the fit between interior design and the daily routines and practices of children and teachers the greater the pedagogical advantage. This is because when design and practice are closely aligned, school communities are more successful in achieving sustainable cultural change.

This research methodology enables architects, designers and school communities to assess the effectiveness of school environments that have been designed or redesigned to promote cultural change. For school communities this means developing a better understanding of how to exploit the potential of professionally designed school interiors to support learning and teaching practices (Lackney, 2008, 2009). For architects and designers it informs ongoing design development of school interiors that will give school communities a pedagogical edge.

Kellee Frith

Kellee Frith is a designer, design researcher, and recent PhD candidate in the Faculty of Design at Swinburne University of Technology. As part of her studies she developed a research methodology for assessing the role of interior design in supporting and facilitating cultural change. Kellee has run training workshops for several Victorian schools and for the Council for Education Planners International (CEFPI). She has also developed a design brief for an immersive learning environment at Melbourne Zoo. Now Kellee is using her research to develop more effective design briefs for school interiors that support and promote cultural change.

The Australian school design landscape is crowded with prototypes for twentyfirst-century learning environments, but are the interiors of these new and refurbished buildings delivering the pedagogical advantage that they promise? Designed in response to new education theories, notably Howard Gardner's (2006) theory of multiple intelligence, these new environments help redefine learning as social, situational, experiential, connected and continuous (Gislason, 2007, 2009; Jamieson, Dane & Lippman, 2005). This redefinition of learning as a collaborative process is central to education reform in Victoria and captured in the Department of Education and Early Childhood Development's advice to schools that accompanied the Victorian Schools Plan (DEECD, 2008) and the Building the Education Revolution program (DEECD, 2009). This paper argues that it is time to find out what influence the interior design of school learning environments is having on changing the culture of learning in Australia.

Despite heightened interest in the design of school learning environments, there is little understanding of how interior design as a discipline and as a professional practice can assist in changing the culture of learning. Education reform is instead concerned with architectural transformation—the development of new school buildings as outward expressions of cultural change (Burke & Grosvenor, 2008; Dudek, 2000), and new spatial patterns as inward expressions of flexibility and collaborative learning (Monahan, 2002). Questions about how spatial organisation; furniture design; use of colour, texture, materials and light; and the integration of specialist tools, resources and technologies might influence child-teacher relationships and either enhance or hinder alternative modes of learning and teaching are overlooked. Neither has any particular attention been paid to the assessment of the interior design of schools in post occupancy evaluations (Cleveland & Fisher, 2014).

This paper outlines a research methodology specifically developed to examine the influence of interior design in changing the culture of learning in primary school learning neighbourhoods, which may be suitable for broader application in the assessment of physical learning environments. It was developed as part of PhD research that was supported by an Australian Research Council Linkage Project grant, '*The School: designing a dynamic venue for the new knowledge environment'*. The key findings of that research are presented in this paper along with some recommendations for schools, design professionals and researchers. The research was conducted at Bialik College and Wooranna Park Primary School, two Victorian schools that have been acknowledged for their pedagogical and design innovation.

A private school, a public school & a professional interior desiger

Bialik College is a private Jewish Day School in inner eastern Melbourne. Originally established in 1942 as a Zionist Sunday School and kindergarten, it now has a student population of approximately 1100 children from three-year old kindergarten to Year 12. Bialik's education philosophy is informed by the municipal infant toddler centres and preschools of Reggio Emilia, Italy and the *Cultures of Thinking*, a research project co-authored by Bialik College and the Harvard Graduate School of Education 's Project Zero research group. In conjunction with its general studies program Bialik runs a specialist Hebrew language and cultural studies program.

Wooranna Park Primary School is a state government funded school in the outer south eastern suburbs of Melbourne, which opened in 1971. Its current student population of approximately 370 children from Prep to Year 6 represents more than 40 nationalities and a wide variety of social and cultural backgrounds. Wooranna is classified as a socioeconomically disadvantaged school, but this has not been a barrier to high academic achievement. Wooranna's education philosophy, like Bialik's, is informed by Reggio philosophies, as well as George Betts' autonomous learner model. It is also heavily influenced by Howard Gardner's theory

of multiple intelligences and Barbara Rogoff's development of Vygotsky's sociocultural theory. Cultural diversity is celebrated at Wooranna and children are encouraged to learn about their own backgrounds and share them with the rest of the learning community.

Featherston's school design practice is influenced by the child-centred education philosophies of Reggio and driven by the Modernist belief in social transformation through good design (Greenhalgh, 1990). Central to her belief that good design can improve the lives of ordinary people is her detailed understanding of children's and teachers' needs. For more than four decades she has been studying and observing children's and teachers' activities and behaviours to assess 'user needs'. This is the starting point for her user-centred, collaborative design process that engages whole school communities in shaping learning environments. United by a shared vision of child-centred education the members of Bialik and Wooranna's leadership teams, together with Featherston, and even the schools themselves are key players in the story of education reform in Australia.

Research methodology

Within the documents that constituted the design briefs for the neighbourhood interiors Featherston designed at Bialik and Wooranna are identifiable patterns of activity and behaviour nominated by the school communities as tangible expressions of the new modes of learning and teaching they were trying to foster. Dance and movement, for example, are equally valid modes of enquiry as reading, writing, mathematics and scientific experiment. The trajectory of learning experience follows children's interests and passions rather than the set curriculum. And children and teachers are partners in the collaborative venture of learning. Children's relationships with their peers are genuinely collaborative also, because the nature of the big ideas and questions that underpin their learning investigations are too big for one child to tackle alone and too complex to solve without deep discussion with their teachers and peers.

By comparing the patterns of how children and teachers used and inhabited their neighbourhoods with the patterns of activity and behaviour nominated by the school communities as indicators of cultural change, it was possible to study the role of interior design in shaping learning cultures. Through observation, interview and visual analysis this study aimed to provide evidence of children's

and teachers' school routines. If these routine patterns of activity and behaviour matched the patterns nominated by the school communities as desirable modes of learning and teaching, an argument could be made in support of the role of interior design in changing the culture of learning. If the patterns did not match, as happened in this study, the questions about the potential of interior design to influence cultural change in primary school learning neighbourhoods are more complex. This study seeks to understand the influence of interior design on human activity and behaviour within the particular environments of primary school learning neighbourhoods. Their pedagogical and design innovations identify them as exemplars of a broader shift in Australian education towards enquiry-based, hands-on, collaborative learning and the development of physical learning environments to suit. Therefore the learning neighbourhoods at each school can be considered is discrete examples of the larger trend suitable for study. This approach described by Stake (2010) uses the context immediate to the 'thing' being studied to define the parameters of a case study. In this study therefore, each learning neighbourhood is a case, a discrete physical, spatial and cultural context in which to study the influence of interior design.

The learning neighbourhoods

Prep neighbourhood, Wooranna Park Primary School

There are 55 children working with three teachers and two student support officers in the Wooranna Prep neighbourhood. Children spend a large portion of each day working in small groups in learning settings across the neighbourhood engaged in negotiated learning activities. This is an unmistakably child-centred environment. The proportions of the learning settings and the scale of the furniture are child-size. Its collection of

FIGURE 1 - *Wooranna Prep Neighbourhood, view of the reading loft*

purposefully designed and interconnected learning settings include an entry gallery, a lounge, an amphitheatre, a listening post and reading loft, a studio laboratory, a darkroom, and settings for target teaching, small and large-scale construction, communication, problem solving and role-play. There is also a drinking fountain, cloakroom and materials store. There are open spaces for children to move and be active and there are enclosed places for retreat to. Abundant natural light reflects off the white walls and creates a bright and welcoming ambience. The floors are laid with durable deep sand coloured carpet and dark grey washable Flotex flooring.

Years 5/6 neighbourhood, Wooranna Park Primary School

There are 110 children working with five teachers and three student support officers in the Wooranna Years 5/6 neighbourhood. It occupies an area equivalent to six conventional classrooms and a corridor. At ground level the original corridor, now the entry gallery, opens onto a large light filled space on the south side of the neighbourhood that houses a drinking fountain, lounge and learning settings for individual and collaborative study, target teaching, small group discussion, and games

FIGURE 2 - *Wooranna Years 5/6 Neighbourhood, view from the games and construction platform*

FIGURE 3 - *One of three Prep neighbourhoods*

and construction. On the north side of the entry gallery is a studio laboratory, a recording studio, and a setting for movement and performance. Upstairs is a second study and an adjoining classroom workshop separated by a sliding glass door. Children's personal storage cupboards are incorporated into the interior design of the learning neighbourhood to create divisions between learning settings.

Prep neighbourhood, Bialik College

There are 73 children working with three teachers and six assistants in the Bialik Prep neighbourhood. The neighbourhood is located at the upper east end of the two-storey Early Learning Centre (ELC) building and comprises three separate homeroom spaces, each with an adjoining mini studio. Each homeroom also shares a separate withdrawal space with a neighbouring classroom. All the homerooms also open onto a shared plaza space that is used for games and largescale construction. Each Prep homeroom has an identical suite of Featherston's child-scale modular furniture that the homeroom teachers use to create purposeful learning settings including a home base and settings for reading and relaxation, small and large-scale construction, computing, communication (writing and drawing), maths problem solving and small group discussions. Each teacher organises the learning settings in her homeroom according to her personal preference and teaching style.

Year 6 Neighbourhood, Bialik College

There are 77 children working with five teachers and two student support officers in the Bialik Year 6 neighbourhood. The Bialik Year 6 learning neighbourhood comprises three separate classroom spaces and a wide corridor on the second floor of the main school building. Low

FIGURE 4 - *One of three Year 6 homerooms*

ceilings, fluorescent strip lighting, grey blue carpet, off white walls, institutional furniture together with royal blue pin boards and door frames give the neighbourhood a uniformly cool ambience. The corridor, which services a small storeroom, an office for specialist language teachers, toilets, a fire hydrant and stairwell, has been appropriated by children and teachers as a collaborative learning setting. It has been modestly furnished with surplus chairs and tables to create a large collaborative work surface and several smaller surfaces for independent study.

Research methods

Three methods were used to generate the research data; photographic observations, semi-structured interviews and visual analysis. Each source of data was used to interrogate the others.

Photographic observations

Synchronous photographic data (Sanoff, 1991) was generated by five wallmounted digital cameras to create a holistic view of each learning neighbourhood, (see Figure 5). This unobtrusive observation system generated small data sets that could be manipulated by the project researchers using standard QuickTime software on a desktop computer. A two-week observation period was scheduled for each school that was split between observations made using the automated camera system and observations made using a hand-held camera.

Semi-Structured Interviews

The interviews conducted with each teaching team focused on the ways that they used their physical learning environments to suit their teaching practices. The focus of the interviews with school leadership teams and Featherston was to discuss the collaborative design processes they used. Select photographs from the observation data were used as catalysts for discussion (Barbour, 2008). Specific questions about the photographs were posed when seeking input from the teachers to contextualise or interrogate the data. Teachers also volunteered information, commenting on how typical or atypical they perceived the photographed scenario to be.

Visual analysis

Visual analysis methods integral to design studies, practice and research (Hall, 2006) that have been adopted and appropriated by designers and design historians from art historians (Bell, 2001; Emmison & Smith, 2002) were used in this research to describe every detail of the interior design in each learning neighbourhood. A similar technique of visual analysis described by Stanczak (2007) as 'open viewing' was used to analyse the photographic data. An observation sheet was used to record a daily narrative of children's and teachers' activities and behaviours by logging the visual data against a time scale. Consistent terminology and ordering of information (people, activity, setting), was used to log the data so that patterns were easy to identify and comparisons between different time-lapse sequences could be made easily.
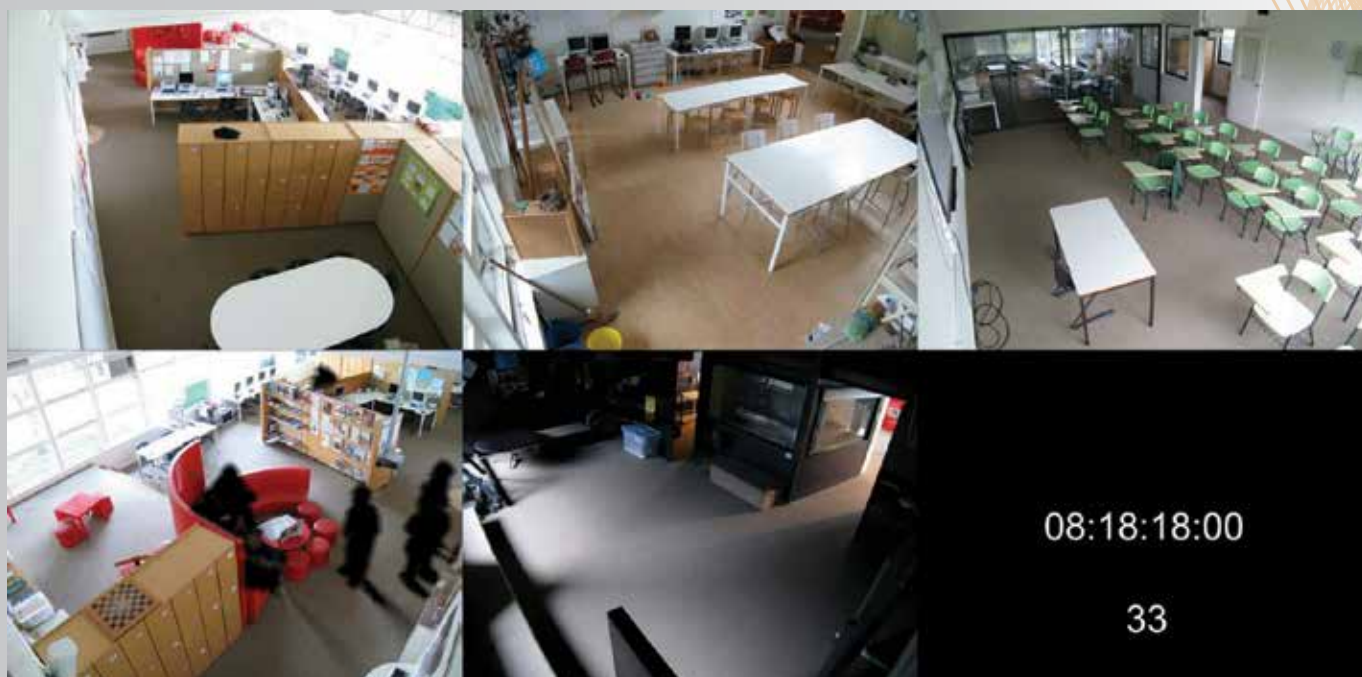

FIGURE 5 - *QuickTime Split Screen Wooranna Years 5/6 Neighbourhood*

Methods of analysis

Archival dcument analysis

The archival documents were analysed to detect any direct or indirect reference to how the school communities intended children and teachers might use and operate in the learning neighbourhoods. These references were used to build up a detailed picture of the kinds of activities, behaviours, groupings of people and organisation of time that we could expect to see as demonstrative of new and desirable ways of learning and teaching. For example Wooranna's raison d'etre document under the heading of pedagogical practice states 'Exploration of and listening to the '100 languages of children' / Multi-literacies developed'. This creates an expectation that there will be evidence in the neighbourhoods of children using a wide variety of work modes and a range of different materials and resources in their learning activities. Therefore an examination of children's patterns of interaction with their physical environment was expected to provide evidence of children using a wide variety of work modes and a range of different materials and resources in their learning activities. This evidence along with other pieces of evidence were used to build a case for the influence of interior design on children's activity and behaviour. Where no evidence of this kind was found possible reasons to explain why children were not using the resources available as expected were explored.

Mapping patterns of activity and behaviour

Using a technique called 'behaviour mapping' (Sanoff, 1991) the observation data was manually plotted onto the relevant floor plans to illustrate the movement of children and teachers within their learning neighbourhoods as shown in Figure 6 (left). These graphic representations were used to examine the ways that individual children and teachers move around their neighbourhoods and the movement trends across a neighbourhood group. A similar graphic technique was used to map the distribution of children and teachers within their learning neighbourhoods. Coloured dots were used to plot their positions recorded in the time-lapse photography sequences as shown in Figure 6. A technique of visual representation used by Preiser, Rabinowitz and White (1988) in post occupancy evaluations of Indiana elementary schools was adapted for this research to illustrate the patterns of children and teachers' interactions with their neighbourhood interiors and with the objects and artefacts they contain as shown in Figure 6. This technique also functioned to protect the identities of the children and teachers illustrated.

Key findings

In each of the case neighbourhoods the enormous potential of interior design to facilitate and promote alternative modes of learning and teaching was observed. However, the photos also showed that children and teachers regularly used particular learning settings in ways that appeared
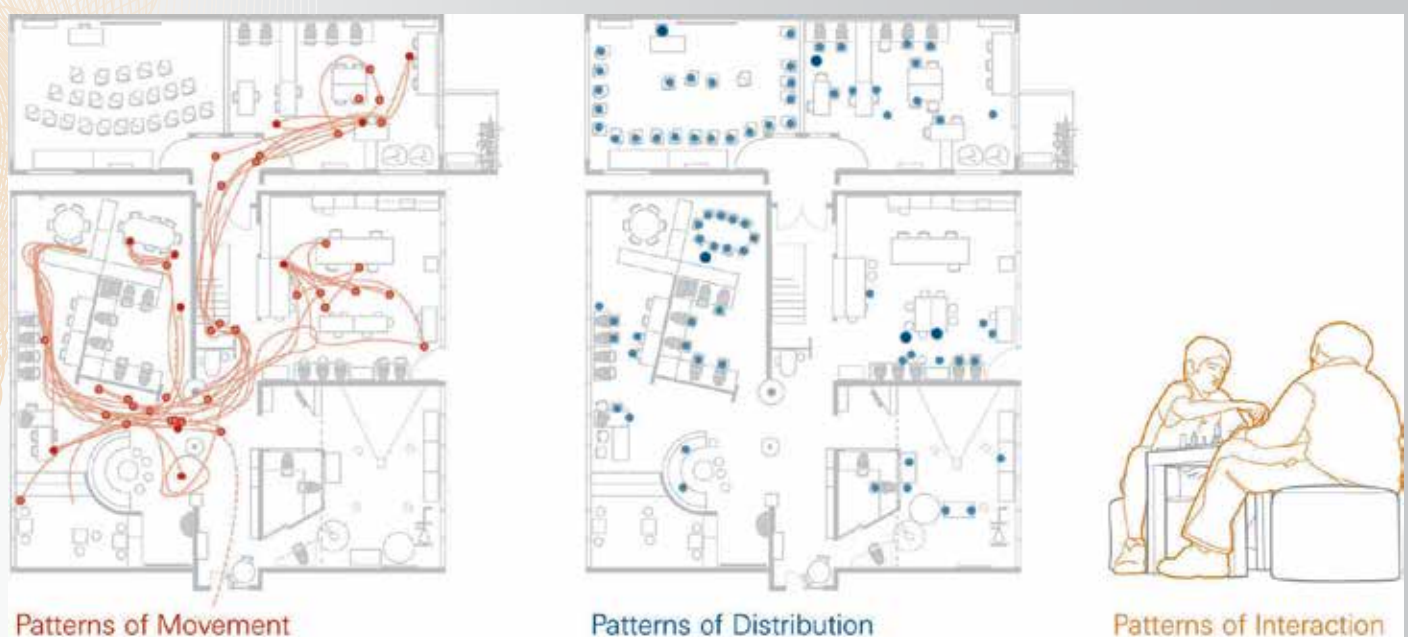

Patterns of Movement   Patterns of Distribution   Patterns of Interaction

FIGURE 6 - *Mapping Patterns Identified in the Photographic Data* - Wooranna Years 5/6 Neighbourhood Plan, Children Playing Chess

to contradict their designed purpose and function. The search for reasons why highlighted the fact that interior design is one of many in a complex web of interdependent influences, which are each critical to creating and sustaining real cultural change. The paragraphs which follow trace one line of inquiry to demonstrate the complexity and interconnectedness of just some of the influences that shape learning culture.

The first of these interconnections was between pedagogical practice and the design of the physical learning environment. The three neighbourhood interiors designed by Featherston were purposefully planned and detailed to suit the schools' child-centred education philosophies that were characterised by in-depth learning investigations in response to things that children wanted to find out about. This meant that when particular settings were used in more conventional teacher-centred ways, such as a setting equipped for games and construction being used for direct instruction, they provided less effective support for children's learning activities than when they were used for their intended purpose. This inevitably raises questions about how permissive purposefully designed environments should be, but those are questions for a separate discussion.

Closer examination of why purposefully designed settings were being used in conventional ways pointed to the significance of clear and consistent pedagogical leadership. For example, when asked why they were engaged in more direct instruction than was expected from the analysis of the archival documents, the Wooranna teachers identified downward trending NAPLAN results as the reason. Cross-checking this with the principals' comments it appeared that teachers had been asked to spend more time working with children to develop their literacy skills in response to the NAPLAN data. The problem was though, at that particular point in time there was insufficient guidance for teachers about how to do that. Instead of using an integrated approach that increased the focus on literacy, but maintained the integrity of Wooranna's curriculum and democratic approach to learning and teaching the teachers reverted to drilling teachers. The principals regarded this as evidence of the need to develop a deeper, more robust understanding of Wooranna's education philosophy and pedagogical vision by its teachers. Interestingly these were issues of concern for the Bialik leadership team also.

The concern for this research though, is that in this scenario the physical learning environment ceased to provide any meaningful support for teachers. One possible explanation for this is that the teachers had not yet developed an instinctive understanding of what the physical environment had to offer and how they might use it to support their specific pedagogical aim of improving children's literacy skills. Thus under pressure they reverted to their teacher training and took control of the situation by assuming the position of the teacher at the front of the room. Across all the case neighbourhoods there were examples of teachers working together and sharing their strategies for solving challenges like this one. The most poignant of these were when teachers comments revealed that the physical learning environment was starting to become part of their pedagogical conversations. This suggests that teachers need more opportunities for professional conversations. It also suggests that these conversations would be helped by ongoing professional development about how to exploit the potential of purposefully designed learning environments.

Some recommendations

For Schools:
- Provide clear and consistent pedagogical leadership for staff that includes supporting, guiding and nurturing new practice.
- Encourage teachers to experiment with the physical environment. This research found that discoveries teachers made for themselves were very valuable in building their confidence in using their spaces.
- Help teachers to preserve time for informal professional conversations as opportunities for peer professional development and exploring the physical environment as a pedagogical tool.
- Build relationships with design professionals who can provide other kinds of professional design development for staff.

For Designers and Architects:
This advice is for all school design disciples, not just interior design
- Consider what materials you have or could develop that might help teachers to recognise the potential of their physical learning environments.
- Foster feedback loops with school communities by inviting teachers and children to tell their stories, they often contain valuable lessons for design professionals.

- Work with school communities and design professionals to understand what they want to know and how it might fit into larger research agendas.
- Consider opportunities to use research as an agent in the design process as well as how to use it to assess and evaluate new learning environments.

Conclusion

This paper has articulated a research methodology that compares the patterns of activity and behaviour, nominated by school communities as indicators of desirable modes of learning and teaching, with how children and teachers actually use their environments. This was done to understand the influence of interior design in changing the culture of learning in schools. This paper also has explained how archival documents were used to formulate a picture of what best practice learning and teaching at each school looked like, and the methods used to generate data that was analysed to find evidence of new modes of learning and teaching in each neighbourhood. Owing to the complex web of influences that shape learning culture, of which interior design is just one, this research has not been able to make definitive claims about the role of interior design in cultural change.

Although this research was conducted in primary school contexts its methodology is equally suitable for studying preschool, secondary and tertiary environments, provided that appropriate ethical considerations are made. For future projects the opportunity exists to study environments before any design intervention to help understand how the design of the physical environment relates to the learning experiences the school community wants children and teachers to have. Using the same research methodology throughout the design process and into post occupancy would provide another unique opportunity to study and manipulate interior design to better support sustainable cultural change which is the pedagogical advantage that all twenty-first century learning environments aim to achieve.

Research stories

As a postscript to this discussion the following pages contain some illustrated stories from the research that this paper draws on. They provide some specific examples of how the interior design of the case neighbourhoods influenced, or was influenced by children's activities and behaviours. And in a small way they provide glimpses into the role of interior design in changing the culture of learning in primary school learning neighbourhoods.

Coloured Pencils

The way that Prep children used tools, materials, objects and artefacts revealed their intimate knowledge of their physical environment and the relationship between material objects and learning culture. The communication setting in the Wooranna Prep neighbourhood is where the writing and drawing materials are. On one shelf there are jars of coloured pencils positioned at child height—one jar of pink pencils, one of orange, one of yellow and so on.

During one negotiated learning period a group of five children, pictured in Figure 7, chose to work together in the communication setting to make a greeting card for their principal. They collected the things they needed from the shelves— paper, glue and scissors. One member of the group ferried the jars of coloured pencils to the table. Another child asked "What if someone else wants a pencil? They won't know where they are, because we've got them all." The children solved this problem by each choosing a different coloured pencil and returning the rest, in the jars, to the shelves. The children's negotiation about the pencils, without assistance or direction from adults, suggests that they had learned and understood the significance of their material environment, as well as their responsibilities towards each other, as members of a collaborative learning community, to share their material resources.

FIGURE 7 - *Sharpening the Coloured Pencils Communications Setting -* Wooranna Prep Neighbourhood

Compendiums

Wooranna Years 5/6 students used zip-up compendiums, as shown in Figure 8, to carry their personal learning materials rather than sharing materials that belonged to everyone as in the Prep neighbourhood. The teachers' assessment was that the compendiums allowed children to be mobile within their neighbourhood. Children used their compendiums as portable workstations, which meant that they could pursue individual study activities regardless of the environmental cues and designed purpose of those settings. For example, in the movement and performance space, a setting without desks or chairs, children used their compendiums as instant workstations as illustrated in Figure 9. This behaviour suggests that the use of compendiums by the Years 5/6 children enabled them to ignore the environmental cues that might signal alternative behaviours appropriate to each setting.

One Space, Two Pedagogies

Figure 10 shows two quite different ways that the small home base setting in one Bialik Prep room was used by the general studies teacher (blue left) and by the Hebrew teacher (purple right). The general studies teacher used this setting for whole group discussions (as shown), games, construction and AV presentations. The Hebrew teacher used the same setting for direct instruction, transforming the setting into a mini classroom space with the small timber stools as work surfaces, as shown on the right. Figure 11 shows that the teachers also negotiated use of the limited wall space in their homeroom by designating specific areas for general studies (left) and others for Hebrew language studies (right).

Collaborative Space

Without professional design assistance and with limited resources the Bialik Year 6 teachers reclaimed what they described as the 'wasted' circulation space in the corridor outside their homerooms and transformed it into a collaborative, autonomous learning environment for Year 6 children, shown in Figure 12. Figure 13 shows how the same space could be used to better support the teachers aim of engaging children in a wide variety of learning activities. By introducing task specific furniture and open storage shelves for tools and materials the environmental cues missing from Figure 12, would suggest possibilities and invite children's engagement.

FIGURE 8 - *Zip-up Compendiums*

FIGURE 9 - *Compendiums equal Mobile Workstations* - Wooranna Years 5/6 Neighbourhood, Games and Construction (above), Movement and Performance (left)
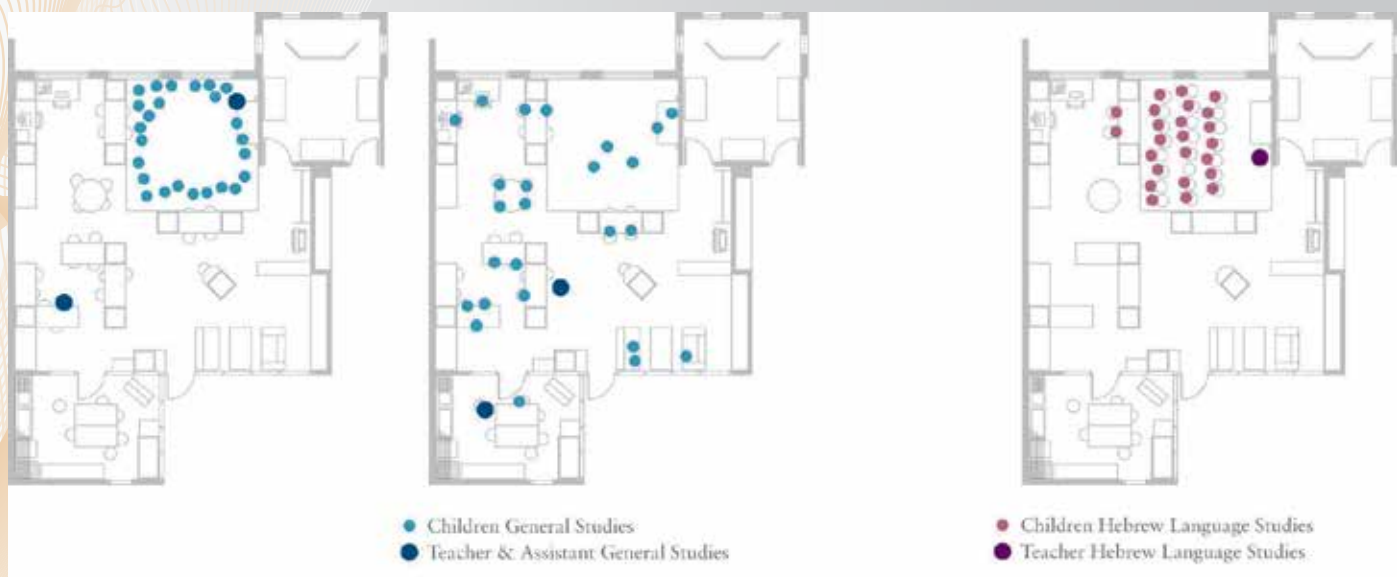
FIGURE 10 - *Spatial Differences* - General Studies (left x 2), Hebrew Language studies (right) - Bialik Prep Homeroom

FIGURE 11 - *Separate Display Zones* - General Studies (left), Hebrew Language Studies (right) - Bialik Prep Neighbourhood
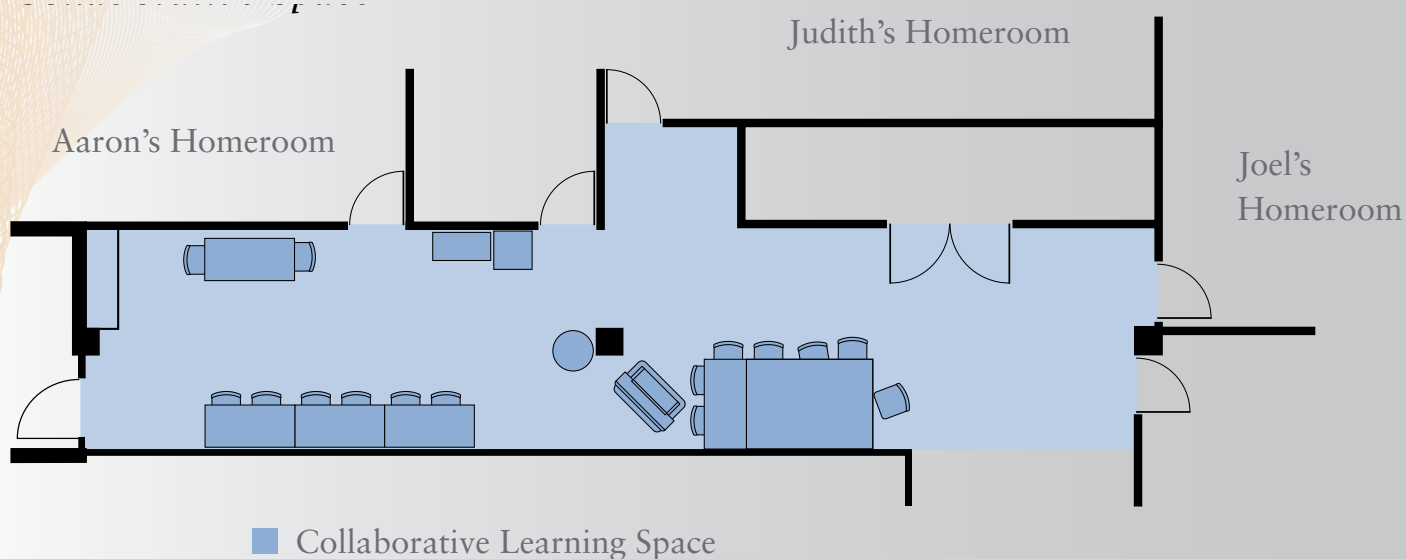
FIGURE 12 - *Reclaimed 'Wasted' Space* - Bialik Year 6 Neighbourhood - Collaborative Learning Space

Aaron's Homeroom

Judith's Homeroom

Joel's Homeroom

🟩 Maths Studio		🟧 Reading Nook	
🟨 Small Group Discussion & Games		🟧 Newspapers, Books & Magazines	
🟨 Games		🟦 Art Studio	
🟪 One-to-One Consultation		🟦 Art Tools & Materials	
		🟨 Display Wall	

FIGURE 13 - *Alternative Spatial Organisation* - Bialik Year 6 Neighbourhood, Collaborative Learning Space

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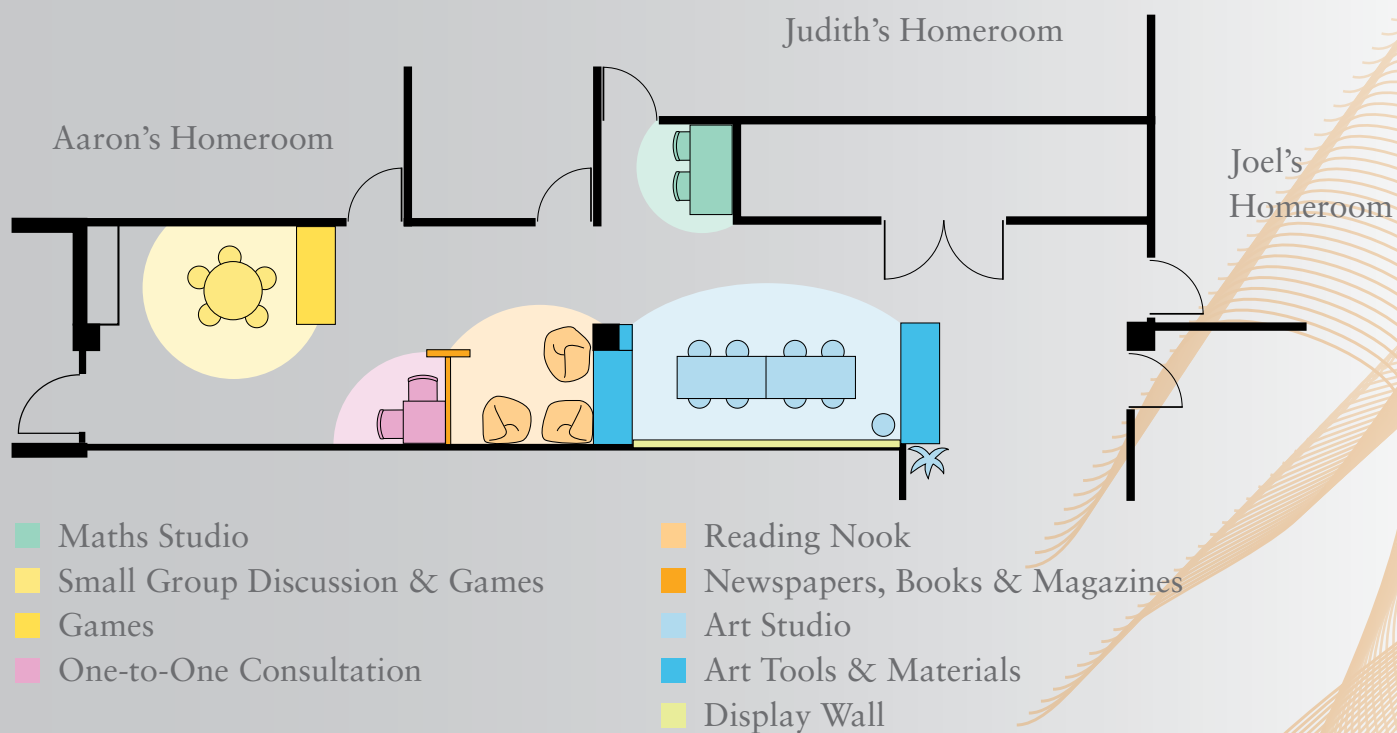
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The empirical evaluation of the transition from traditional to New Generation Learning Spaces on teaching and learning

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The New Generation Learning Spaces (NGLS) project developed an empirical evidence-base to support the re-design of technology-enabled learning spaces, matched with a quasi-experimental evaluation of the effect on teaching and learning. This presentation will focus on the third stage of the NGLS study at the Anglican Church Grammar School (Churchie). The aim of this stage was to evaluate and understand the micro effects on teaching and learning that occur in the transition from a traditional classroom to a NGLS. A Single-Subject research design compared the activity and behaviour of the same teacher (n = 11) and class (n = 14) through a repeated measures paired-observation approach.

In a departure from traditional observational techniques, a novel observational metric was developed to produce real-time breakdown of activity across five domains (pedagogy, learning experiences, communities of learning and student and teacher use of technology). The metric's use was two-fold. Firstly, its instantaneous visual feedback provided an efficient medium for teachers to better understand their practice, and its affects on their students, in transition from traditional cellular spaces to the 'open studio' design of the NGLS. Secondly, the generation of empirical observational data enabled visual analysis of both individual teachers and faculty groupings through the spatial transition. This process identified functional changes and trends across the five domains, which were attributable to specific spatial elements of the NGLS design. This analysis provided an initial snapshot of how the affordances of different spaces, can shape the microelements of teacher and student activity and behaviour.

Terry Byers

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Introduction

Interest in learning environments or spaces is a growing research field (Alterator & Deed, 2013; Cleveland & Fisher, 2014). This interest has seen the evolution of the term 'learning environments' to mean much more than the physical space in which learning takes place; to encompass both pedagogical and psychosocial elements of such environments (Jindal-Snape et al., 2013). Mulcahy (2015) has described how this interest has prompted a "re-consideration of learning and the spaces in which learning takes place" (p. 500). This interest has spanned from the appraisal of traditional designs through to suggestions of different models (Dovey & Fisher, 2014; Gislason, 2007). Dovey and Fisher (2014) suggested that the traditional 'cellular' classroom constrains the 'multiplicitous' nature of more student-centred pedagogies. To support these pedagogies, spaces need to be fluid and responsive in design and function (Alterator & Deed, 2013; Lippman, 2010). Also, Byers and Imms (2014) suggest that these spaces can better support the effective use of digital technology. These suggestions assume that a spatial change is an agent for pedagogical change (Oblinger, 2006).

This interest has coincided with significant innovation and investment in 'new' educational spaces (Dovey & Fisher, 2014). In their literature review, Blackmore, Bateman, O'Mara, and Loughlin (2011) noted that much of the research has concentrated on the physical aspects of the spatial design. Authors have established the specific environment conditions (i.e. air quality, lighting, noise, temperature, ventilation) optimal for student learning (Barrett & Zhang, 2009; Barrett, Zhang, Moffat, & Kobbacy, 2013). However, Blackmore et al. (2011) identified that this evidence base has yet to establish what happens once these new space are in use.

This imbalance in the evaluation of new space has been recognized by a number of authors (i.e. Blackmore et al., 2011; Hall-van den Elsen & Palaskas, 2014; Mulcahy, Cleveland, & Aberton, 2015). Barrett and Zhang (2009) identified this spatial transition from existing to new spaces as a "finished beginning" (p. iv). However, Hall-van den Elsen (2013) and Willis, Bland, Hughes, and Elliott Burns (2013) found little evidence examining the effects of this transition on teachers and students. Furthermore, Lackney (1998) is of the view that how teachers utlilise the affordances of these new spaces or their 'environmental competency' has been largely overlooked. Thus, it is unclear if, and how, this spatial change realizes its envisioned pedagogical change (Blackmore et al., 2011; Mulcahy et al., 2015; Willis et al., 2013).

This small study followed teachers through the transition from traditional to NGLS at the Anglican Church Grammar School (Churchie). The aim was to illuminate if a change in space correlated to any pedagogical change. A single-subject research design (SSRD) evaluated this transition using the Linking Pedagogy, Technology and Space (LPTS) real-time observation metric. The metric produced an empirical breakdown of teacher and student activity. Subsequent visual analysis identified the degree of an individual's pedagogical change through the spatial transition. The subsequent findings presented here found that there was a degree of pedagogical change associated with the spatial change. This novel approach has the potential to evaluate and track the pedagogical effect of different learning spaces. The longer-term pedagogical effects of a spatial transformation will be addressed in subsequent articles.

Background

The interest in redesigned spaces

The pedagogical effects of different learning spaces was acknowledged in the works of Dewey. Dewey (1916/2005) identified the mediating role of educative spaces in Democracy and Education. Dewey's philosophies informed the 'open-plan' classroom movement (1960s and 70s) and the post-war Reggio Emilia's early childhood movement

(Upitis, 2004). The former was the first significant top-down architerctural-inspired spatial departure from the cellular classroom developed during the Industrial Revolution (Lackney, 1998). Where as, the Reggio Emilia (similar to Frobel, Steiner and Waldorf) movements saw space as the "Third Teacher" and spoke more of a bottom-up user-orientated emphasis (Tarr, 2014; Upitis, 2004).

The affordances of new digital technologies and the re-emergence of student-centred pedaogies, has reignited the current interest in learning spaces (Dovey & Fisher, 2014). For too long the unconciousness regarding the power and influence of space, has seen the classroom environment become one of the few unchallenged and unchanged 'constants' in education (Fisher, 2004; Gislason, 2007; Scott-Webber, 2012). Rather than being tight, rigid and static containers (Brown, 2006; Fisher, 2006; McGregor, 2004b), there is a growing demand for spaces to perform pedagogically (Dovey & Fisher, 2014). Authors have suggested that the classroom is no longer a neutral setting, but an 'active agent' in the teaching and learning process (Burke, Grosvenor, & Norlin, 2014; Mäkitalo-Siegl, Zottman, Kaplan, & Fischer, 2010; Oblinger, 2006).

Growing attention about the design of classroom spaces has sought to connect spatial characteristics and technologies to particular pedagogies and learning experiences (Dovey & Fisher, 2014; Jindal-Snape et al., 2013; Upitis, 2004). Underlying this interest is the assumption that spaces are an embodiment of and mediate between specific definitions of learning (Gislason, 2007; Thomas, 2010). Even though spaces do not gesture, speak or think, there is the emerging view that their built pedagogy has the potential to 'shape' the behavioural, relational and social elements of teaching and learning (Gislason, 2007; Lefebvre & Nicholson-Smith, 1991; Massey, 1999; Melhuish, 2011; Monahan, 2002).

This requires spaces to act as a conduit for and be responsive to the dynamic convergence of social interactions, occupation and learning modalities (Dovey & Fisher, 2014; McGregor, 2004b; Thomas, 2010). Classrooms need to become less 'a' teacher space and a more a 'learners' space (Chandler, 2009). This requires spaces to be sympathetic to a more progressive view of learners as active, collaborative and constructive in their activities (Dovey & Fisher, 2014), and at the same time, provides for a much wider range of pedagogical practices (Mäkitalo-Siegl et al., 2010). These may range from teacher-centred direct instruction through to 'multiplicitous' pedagogies of student-centred learning (Dovey & Fisher, 2014).

The evaluation of classroom spaces

The evaluation of the potential effects of different learning spaces on teaching and learning is a deeply complex field (Boddington & Boys, 2011; Woolner, McCarter, Wall, & Higgins, 2012). For Gislason (2010) an underlying problem has been the delineation between the architectural and physical affordances of the spaces and the teaching and learning process. In a recent literature review, Cleveland and Fisher (2014) noted that authors in the learning environment research field have often focused on social or psychosocial environments (see Aldridge, Fraser, Bell, & Dorman, 2012; Dorman & Fraser, 2009; Zandvliet & Fraser, 2004). Cleveland and Fisher (2014) found that there were fewer studies that focused on the influence of the physical space on teaching and learning.

Much of the empirical research in the learning spaces field, has focused on the tangible aspects of the physical environment. Here it is commonly claimed that teachers' utilisation of space makes a difference to pedagogy, and therefore, must impact on student learning outcome (Joint Information Systems Committee, 2006). The recent works of Barrett et al. (2013) and Barrett and Zhang (2009) established those physical conditions (i.e. air quality, light, noise, spatial density, temperature and ventilation) that effect optimal teaching and learning. However, there is currently limited empirical evidence that has attempted to measure the effect of a spatial transformation on teacher behaviour and pedagogies and student learning outcomes (see for exceptions, Brooks, 2011; Byers & Imms, in press; Byers, Imms, & Hartnell-Young, 2014). Mulcahy et al. (2015) are of the view that this evaluation suggests a form of architectural determination, or a realist perspective, that seeks a direct causal link between space and its occupants.

How teachers and students utilise space as an element of the curriculum and how this shapes their behaviour remains an under-researched phenomenon (Blackmore et al., 2011; Chandler, 2009; Gislason, 2010; Higgins, Hall, Wall, Woolner, & McCaughey, 2005). Woolner, Hall, Higgins, McCaughey, and Wall (2007) are of the view that the take-up of the affordances of new learning spaces depends on teachers identifying and then exploiting this potential. This more relationalist perspective takes a contrary view to the modernist

(realist) view that there is a direct fit between space (existing and new) and its effects on its occupation (Boys, 2011; Mulcahy et al., 2015). Instead, Mulcahy et al. (2015) suggested that a relationalist perspective takes a mutually constitutive relationship between spaces and its use. For Blackmore et al. (2011) this indicates a need for greater emphasis on those intangible aspects of the ways that teachers and learners react, respond and use the spaces to enhance and optimise teaching and learning experiences.

Evidence of teacher change through spatial transition

The transition of teachers and students into new spaces can extend well beyond the initial 'inhabitation' (Blackmore et al., 2011). In their literature review, Blackmore et al. (2011) found the this transition from existing to new learning spaces has received limited attention in the literature. Hall-van den Elsen (2013) and Willis et al. (2013) also found little exploration of the effects of this transition on teachers and students. This touches on the view of Lackney (1998) that teachers' 'environmental competency', how teachers utilise the affordances of space, has been largely overlooked to date.

This transition phase into a new building or space is incredibly important to its longer-term pedagogical success. For many teachers who are used to particular types of spaces (i.e. cellular or single spaces), effectively transitioning into using new spaces can be difficult (Blackmore et al., 2011). This spatial transition challenges the environmental competency of many teachers, to employ novel practices in unfamiliar spaces (Gislason, 2010; Higgins et al., 2005). Thomson, Jones, and Hall (2009) identify that there is a risk in teachers reverting to their "default pedagogies", at the expenses of any form of the pedagogical exploration and innovation.

The study

The aim of this study was to investigate if a spatial transformation from a traditional classroom to NGLS influenced the types of pedagogies, groupings and technologies used by teachers to create particular learning experiences. The hypothesis of this study was that different spatial layouts would have an effect and teacher behaviour and pedagogies and the learning experiences created. Hence, to understand this relationship further, what was of interest to this study is:

1. If you move a teacher and their students from a classroom that has a traditional layout to into a New Generation Learning Space (NGLS), how does this effect teacher behaviour through the types of pedagogies employed?
2. How do different spaces affect the types of learning experiences encountered by students?
3. How do different spaces effect how teachers groups students in different communities of learning (i.e. whole class, individual, small groups, mixed number groups and mixed class/year levels)?
4. How do different spaces this move effect how teachers and students use different technologies (including digital and spatial)?

The spaces

The study took place in two existing conjoined buildings, which housed the Creative Arts (Drama, Film, Television and Media and Visual Art) Design and Technology (Design and Technology, Engineering and Technology studies) faculties. The original design of the buildings had specialist teachers in their specialist spaces. These specialist 'cellular' spaces were 'traditional' in layout, with furniture arranged in a fixed and rigid setting. This furniture faced the privileged 'fireplace' teaching position at the front of the room, delineated by a teacher desk, whiteboard and data projector screen (Reynard, 2009). The use of these spaces was often teacher-oriented and subject-specific, with little or no inter-disciplinary overlaps in teaching or learning.

The school had planned to refurbish the spaces, building on the earlier designs and findings of the Byers and Imms (2014) and Byers et al. (2014) studies. These studies explored and empirically evaluated how different spatial designs affected teaching and learning. This work had developed an evidence-base to support the re-design of other learning spaces in the school, matched with an evaluation of the effect of this change on pedagogies and learning experiences. The outcome of this research was the design and construction of the 'Creative Precinct'. The Creative Precinct brief was to bring the co-joined buildings and faculties into one dynamic and responsive pedagogical space.

Considerable teacher and key stakeholder consultation influenced the design of the Creative Precinct. This process identified a range of epistemological and pedagogical commonalities between the subjects; while these are multi-faceted, they centred on notions of design and creativity.

The consultation informed that architectural brief to create a space, which could bring the problem-solving and project-based nature embedded in these subjects together. The subsequent design employed an 'open-studio' approach. The aim was to allow students to occupy and transit between didactic teaching spaces, specialist technology-enabled workshop areas, and highly flexible inside and outside communal spaces. This dynamic cycle of occupation and transition intended to support students' transit through the intuitive creative process of conceptualization, design, creation, appraisal and refinement of their work. In this design it was conceived that students and teachers could enjoy easy access to Fisher (2006)'s three spatial modalities (mode 1 - teacher-centred; mode 2 - student-centred; and mode 3 - informal) in all learning spaces at all times. The design acknowledged the fact that technology mediated, creative learning occurred in a variety of settings, with a range of people (both staff and peers) and through a variety of modes.

A 'responsive design' approach enabled the space to shape the learning context of the student, and at the same time, enabled teachers to influence and mould the space to their pedagogical intent (Lippman, 2010). The aim was to support teachers too easily and efficiently transition between Fisher's modalities within the existing timetable lesson

time. This was facilitated through a combination of flexible non-traditional furniture (e.g. raised tables and stools, booths and ottomans) integrated with more traditional desks and chairs to create a complete and interactive 360° or 'polycentric' learning environment (Dovey & Fisher, 2014; Miller-Cochran & Gierdowski, 2013). The intent of the polycentric layout was to de-emphasise the traditional front-focal point or 'fireplace' and to stimulate active teacher amd student movement around the various spaces (Lippman, 2013; Reynard, 2009). Now built, the studios and workshops did not resemble tight, static, hierarchical containers of learning of the past. Instead, they have become social and inviting spaces that encourage a convergence of expertise (student and teacher), pedagogy and technologies (both digital and equipment) throughout the building.

Research design

This study employed a Single-Subject research design (SSRD) to compare the activity and behaviour of the same teacher with the same class through a time-series quasi-experimental approach (Kratochwill, 2013). Each teacher acted as his or her own control, baseline and unit of analysis (Casey et al., 2012). A baseline/intervention (AB) design measured effect of a change in learning
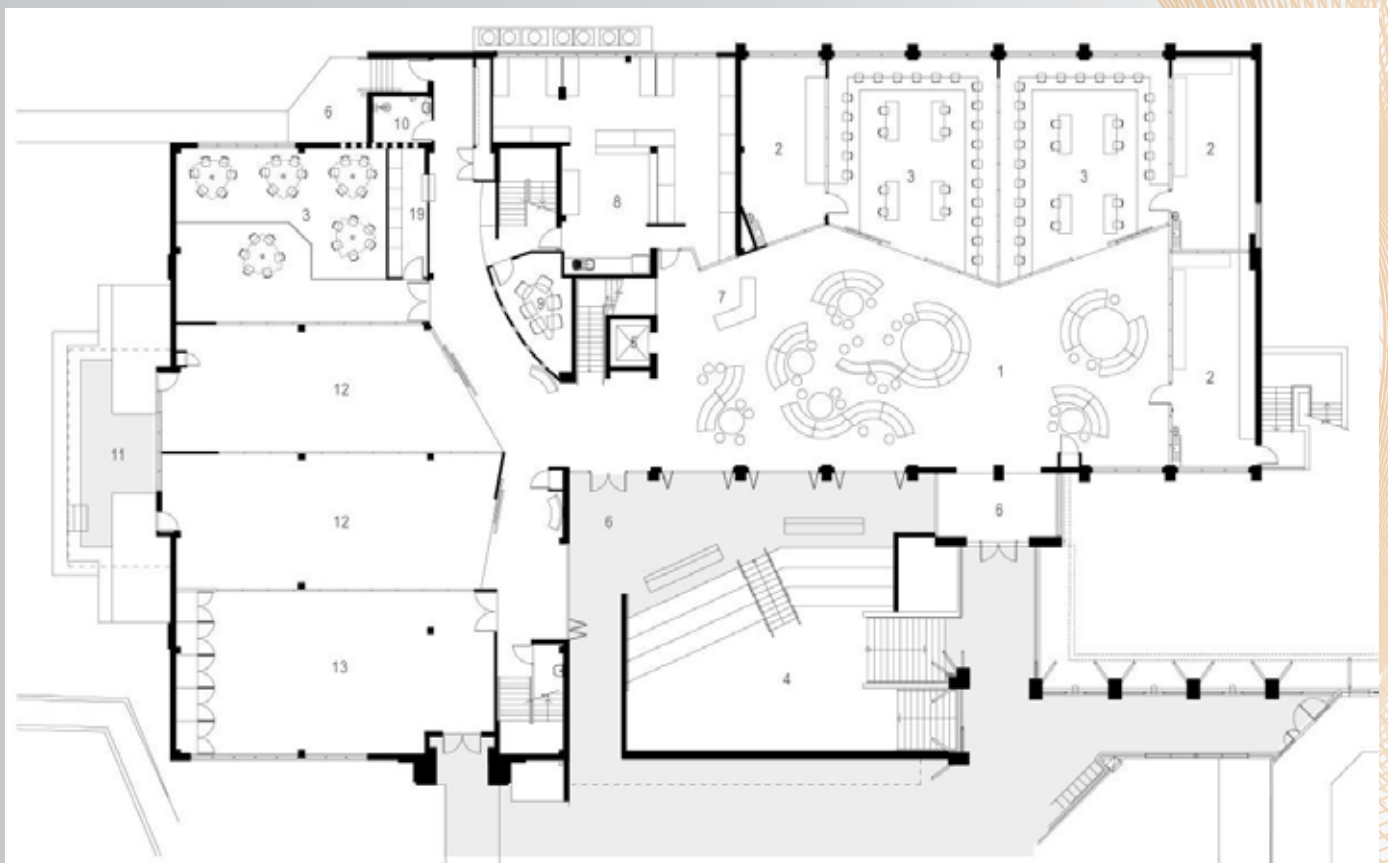

FIGURE 1 - *Hayward Midson Creative Precinct (NGLS) entry floor plan*

space (independent variable) on communities of learning, learning experiences, pedagogies and technology usage (dependent variables). The repeated measures paired-observation metric produced quantitative data of a subject's (student and teacher) activity. This time-series data was plotted and subjected to visual graphic analysis.

Sample

The sample consisted of consenting teachers ($n = 11$) from Design Technology ($n = 6$) and Visual Art ($n = 5$) Faculties. The sample consisted of teachers from the full spectrum of the Australian Professional Standards for Teachers Career Stage levels of Graduate ($n = 2$); Proficient ($n = 5$); Highly Accomplished ($n = 3$); and Lead ($n = 2$) (Australian Institute for Teaching and Leadership, 2015). Each of the participating teachers had some level of professional experience in their field prior to or in association with their teaching degree.

Method

The study employed the LPTS observational metric to analyse the behaviour of both teachers and students within the traditional (baseline) and NGLS (intervention) space. The LPTS metric times the activity and behaviours associated with five domains: pedagogy; learning experiences; community of learning; and student and teacher use of technology. A similar functionality was built into the International Society for Technology in Education (ISTE) Classroom Observational Tool (ICOT). The LPTS metric records, compiles and produces a proportionate breakdown of the observed lesson. For easy interpretation and comprehension, the LPTS metric is able to produce a single and/or paired observation visual breakdown in the form of bar graphs. In addition, the complication of numerous observations for the same teacher and Faculty enables efficient visual analysis.

Prior to the study, the LPTS metric was piloted with three observers. As recommend by Bielefeldt (2012), the chi-square frequencies on the ratings of 9 teachers (not participants in this study) were observed by each of the three observers on a total of 18 occasions. There were no statistically significant differences ($p > .05$) in the times recorded for the dimensions for each dependent variable. This pilot testing suggested the LPTS metric had adequate interrater reliability, similar to that of the original ICOT (Bielefeldt, 2012).

The time-series quasi-experimental design focused on establishing effective controls of confounding variables to maximise the study's internal validity (Gersten et al., 2005; Kratochwill, 2013). To control the variables of class composition and time of the school day, the LPTS was utilised to observe the same teacher, teaching the same class, during the same timetable period (school ran a fortnightly timetable cycle). To moderate the effect of the 'teaching and learning cycle', each teacher was observed three times prior to and post the spatial transition from traditional to NGLS. In addition, systematic sampling ensured adequate coverage of subjects and year-level. Therefore, three teachers (in the Visual Art Faculty) were observed teaching two different classes to ensure adequate subject and year-level coverage. This resulted in 84 observations (42 pre- and 42 post-intervention) recorded over a school semester (20 weeks).

To determine if the spatial transformation had any effect on teacher and student behaviour,
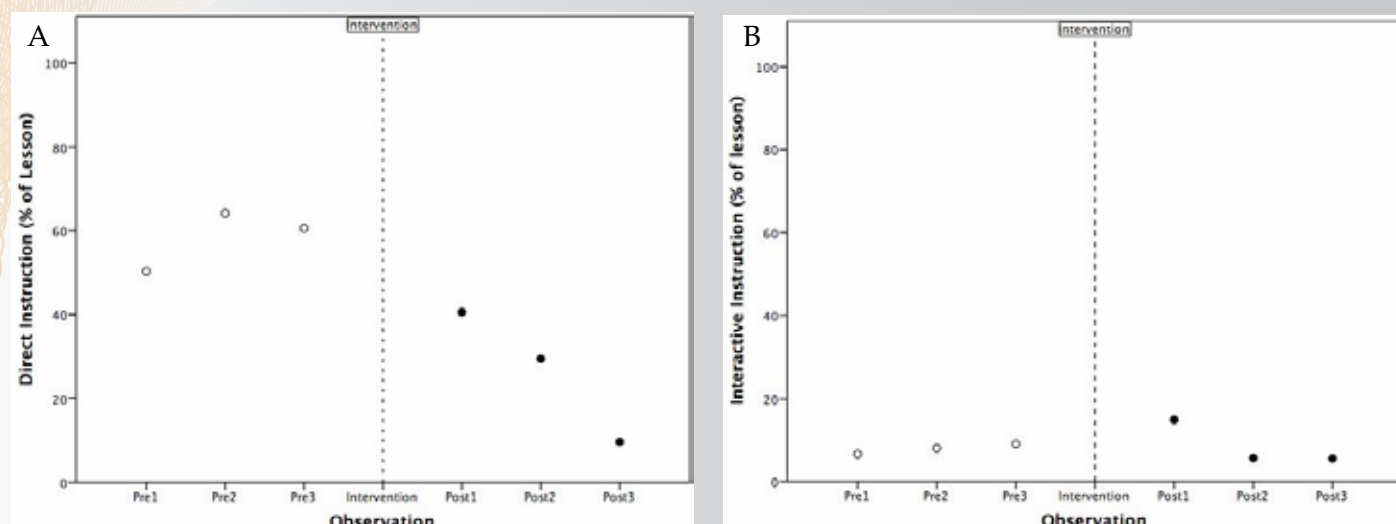

FIGURE 2 - *Application of visual analysis criterion to LPTS observational metric data*

analysis of the quantitative data from the LPTS metric was undertaken through visual analysis. The aim was to determine a functional relationship between the independent and dependent variables. The visual analysis criterion adapted from the literature (i.e. Byiers, Reichle, & Symons, 2012; Kratochwill, 2013) consisted of: level, trend, immediacy of the effect, and variability. Exemplars of the application of this criterion are provided in Figure 2. Panel A shows a clear and immediate difference between the baseline and intervention in level, with a decreasing (or negative) trend in the intervention phases. This analysis would suggest a functional change in teacher behaviour through the intervention phases. On the other hand, Panel B shows no visual difference (no functional change) between a stable (low variance) baseline and intervention period.

Results and discussion

Pedagogy

The pedagogy domain of the LPTS metric was comprised of the attributes: direct instruction, interactive instruction, facilitation, providing feedback, class discussion, and questioning. The most significant functional change through the spatial intervention was associated with the direct instruction attribute. The visual analysis identified that eight teachers had a function decrease in the proportion of time spent in a direct instruction mode through the spatial transformation. For these teachers, there was a general trend in increasing the proportion of the lesson that engaged more 'active' pedagogical modes (i.e. interactive instruction, facilitation and providing feedback). Interestingly, teachers appeared to swap overtly didactic modes of direct instruction, and increased instances of more interactive (i.e. hands-on demonstration) instruction in the NGLS. All teachers spent considerable time, throughout the study, engaged in the mode of facilitation. Teachers were generally assisting and observing students engaged in the 'creation' phase of teaching and learning sequence. However, there was an increase, but not significant, after the NGLS intervention. Finally, there was no functional change observed in the general low incidence of class discussion and questioning throughout the study.

Learning experiences

The learning experiences domain of the LPTS metric included the attributes: receive instruction, conceive, create, appraise, refine, drill and practice, hands-on and students disengaged. For the purposes of the metric, students disengaged was when more than a quarter of the observed class was off-task. There were significant functional change through the spatial intervention in a number of learning experience attributes. The students of 7 teachers spent significantly less time engaged in the learning mode of receiving instruction, which was correlated to the direct instruction pedagogical mode findings. There was significant positive increase in lesson time spent on students engaged in the higher-order activities of create, appraise and refinement. This was associated with a substantial increase in time spent by students engaged in hands-on or practical tasks. Interestingly, this shift to more hands-on and higher-order cognitive tasks resulted in a statistically significant decrease in time that students were disengaged or off-task. For all but one teacher, there was a significant visual decrease in the proportion of the lesson that their students were off-task post the spatial intervention. This trend warrants further investigation to determine if this change in student behaviour is due to the 'novelty' of a new environment, or alternatively, due to pedagogical changes made by their teacher/s.

Community of learning

The community of learning domain of the LPTS metric include the attributes: individual, group (same number), mixed groups (different numbers), whole class, mixed class, and mixed year-levels. Substantiating the trends in the direct and receive instruction pedagogical and learning modes, the time spent in a whole class and individual modes decreased in the NGLS. In the NGLS, there was a greater incidence of students working in groups. Of note, there was substantial increase in students working in various size or mixed groupings. Finally, the only teachers that embraced the concept of mixing classes or 'team teaching' were the Visual Art teachers. Through the spatial inte rvention, these teachers used the affordance of the open studio, to enable classes (of the same year level) to work together in a merged pedagogical space.

Student and teacher use of technology

The use of technology domain of the LPTS metric included both digital and spatial technological attributes. The aim was to observe how different spaces affected the use of different technologies. The most significant functional changed observed by teachers was the significant reduction in their use of digital technology (tablet PC and data projector) in a teacher-centric mode 1 layout. This would appear to corroborate the decrease in direct instruction observed in the pedagogy domain. This trend could suggest that teachers tended to use digital technology in the passive dissemination of content and information, which has been identified by Cuban, Kirkpatrick, and Peck (2001) and Cuban (2001).

All teachers after the intervention did increase the use the informal (mode 3) and spaces outside the timetabled space. The teachers utilised these additional spaces, whilst students were arranged in different size groupings. This appeared to assist in the facilitation of more differentiated student tasks. This increase in usage is significant, given that the design of the building was intended to facilitate this multi-use of space. This trend warrants further investigation to follow teachers' longer-term use of multiple spaces, beyond the initial spatial transformation.

For the students, there was significant increase in the use of digital and spatial technologies. The NGLS intervention was associated with a substantial increase in the use of their personal tablet PC and the application of CAD and multimedia software. In a similar vein to teachers, the students appeared to increase their occupation of informal and outside spaces. Rather than being confined to the same space at the same time, as observed in the traditional classroom, students occupied a greater range of spaces in the single lesson.

Conclusion

The current interest in and redevelopment of contemporary learning spaces has been driven by the premise that they will facilitate a desired pedagogical change. However, there has been limited empirical evidence showing how these spaces have realized this envisioned changed. This study attempted to illuminate how a spatial transformation, from traditional classrooms to NGLS, affected both teacher and student activity and behavior. The SSRD evaluated Design and

Technology and Visual Art teachers through this transformation through the LPTS real-time observation metric.

The visual analysis of the metric's quantitative data identified that the change in space did change particular elements of teacher pedagogical practice and student activity. There was a general trend away from a high proportion of didactic and teacher-centric (mode 1) whole class instruction. After the NGLS intervention, this pedagogical mode was still observed, but much shorter and more focused in its intent. In its place was an increased prevalence of more active pedagogies facilitated in more informal (mode 3) arrangements. Teachers did utilise the affordances of multiple spaces to facilitate increased instances of student collaboration in mixed number groups. How teachers plan for and utilise this spatial affordance, in the longer term, warrants further exploration to determine the longer-term pedagogical effects.

This shift from teacher-centric to more student-centric pedagogies did have an effect on the types of student learning experiences observed. In the traditional classroom, learning was overtly a passive and sequential activity directed by the teacher. In the NGLS, there was a shift to more active pedagogies. There appeared to be greater levels of activity differentiation, in which, the students were engaged at different stages of the creative process. The teachers spent more time providing feedback (appraisal) and suggesting future direction (refinement) to individual and groups of students. The open studio design of the NGLS supported the effective and efficient movement of students through their activity in different spaces. Therefore, this observed change had a significant effect on reducing student distraction and off-task behaviours.

This study demonstrated how the affordances of different spaces, can shape the microelements of teacher and student activity and behaviour. These findings do suggest that the LPTS observation metric, analysed through a SSRD approach, has the potential to evaluate teacher and student experiences in different learning spaces. However, to improve the generality and validity of both the approach and the LPTS metric, a longer-term evaluation of teacher change and the effects of different contexts/spaces is required. Finally, subsequent article/s will focus on the longer-term effects of a spatial transformation on teacher behavior and pedagogies.

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'Finished beginnings': Finding space for time in collaborative teacher practice

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The design of Modern Learning Environments (MLEs) in New Zealand primary schools follows a global shift in thinking about the relationships between pedagogy and space. MLEs that deliberately group larger cohorts of teachers and students signal a spatial intentionality for teacher collaboration. This study focuses on the nature of that collaboration and the impact on the professional work of teachers, both at the interface with students and behind the scenes.

The study is being completed in three phases. The first phase consists of interviews with selected educational leaders across New Zealand to identify key themes as well as potential research sites. This builds on the notion of Reputational Site Selection (Goetz & LeCompte, 1984; LeCompte & Schensul, 2010), as well as the practice of identifying and examining practice in exemplar learning environments (Blackmore et al., 2010; OECD, 2013). Subsequently a set of snapshot case studies will be conducted in six primary schools, with data collected through observations, semi-structured interviews with principals, and focus groups of teachers and students. Three schools will then be selected for in-depth case studies (Stake, 1995), with data collected through field journal observations, interviews and documentation.

Initial analysis taken from the first phase of the study indicates that as schools move to occupy new spaces and inhabit them on an ongoing basis, emergent issues for teachers and leaders are concerned less with the spatial and instead with the relational, temporal, and organisational dimensions. Effective teacher collaboration in MLEs takes time, negotiation and ongoing systemic support, and is shaped and reshaped over time. While geographical proximity may present opportunities for teachers, it also presents complex challenges at a professional, social, cultural and cognitive level. This paper illuminates some of this emerging complexity and supports the notion that although MLEs potentially provide a catalyst for change, the newly built environment presents schools and teachers with a 'finished beginning': a starting point from which adaptations to support successful teaching and learning can occur.

Footnote: The terminology of Modern Learning Environment (MLE) is utilised here, reflecting current usage in New Zealand. It is acknowledged that the language is in the process of shifting towards 'Innovative Learning Environments' and 'Innovative Learning Spaces'.

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Chris Bradbeer is an Associate Principal at Stonefields School in Auckland, opened in 2011. Being involved in developing a vision for teaching and learning, building teacher capacity in order to raise student achievement, and having the opportunity to consider 'what might be possible' has provided much of the impetus behind a research interest in learning environments. Chris' interest is particularly focused on the opportunities engendered by the provision of new learning spaces, in particular the nature of collaborative teacher practice.

Introduction

The shift away from traditional 'single-cell', primary school classrooms, towards more adaptable, flexible and future-focused 'Modern Learning Environments' (MLEs), represents a major change in New Zealand's educational property direction, and the terrain of learning space design. It reflects a global shift in thinking about the relationship between pedagogy and space, and calls for teachers to have a greater understanding of the role that built school environments play in creating contexts for contemporary learning and teaching activities (Fisher, 2004). Critically though, MLEs that deliberately group larger cohorts of teachers and students together signal a spatial intentionality for teacher collaboration.

In accompanying the reconceptualisation of spatial settings, this adjunct shift to multiple teachers operating within them proffers a stark contrast to the spatially isolated historical precedent model of individual teachers operating in isolation within traditional classrooms. Such MLE spaces are designed purposely for groups of two, three, four or more teachers to work together with a larger cohort of students. Inherently with such an up-scaling of space new environments may give rise to a shift in the nature of the relationships between teachers, and between teachers and their students, as well as the activities that take place within them. For some teachers new spatial settings may also precipitate a considerable change in the way they work, particularly in what they do with their colleagues. For others they may provide a catalyst for schools to consider the nature of teaching and learning and the way that it is organised and structured (Alterator & Deed, 2013; Campbell, Saltmarsh, Chapman, & Drew, 2013; Deed, Lesko, & Lovejoy, 2014; Saltmarsh, Chapman, Campbell, & Drew, 2014).

As MLE spaces undoubtedly bring teachers into closer geographical proximity, arguably many of the opportunities and challenges that occur do so at a professional, pedagogical and cognitive level. In describing teacher and student occupation of a new school building Barrett & Zhang (2009) frame it as a 'Finished beginning', as merely a point from which to start. It is particularly apt when used to describe the emergence of models of teacher collaboration and reflects underpinning complexities and localised contextualities.

In seeking to understand the nature of teacher collaboration within MLE spatial settings this project follows a growing trend in research aiming to understand the relationship between new generation teaching and learning spaces, teacher occupation of new spaces, as well as a need to better understand collaborative structures (Alterator & Deed, 2013; Blackmore, Bateman, Loughlin, O'Mara, & Aranda, 2011; Cleveland, 2011, 2013).

Teacher collaboration

If teacher collaboration has long been viewed as a powerful component of effective school and educational outcome change, then the development of effective teams of teachers working together within schools is increasingly seen as part of a solution to educational problems regvarding quality of teaching, school improvement and outcomes of student learning (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; European Commission, 2013; Hattie, 2012). Furthermore, in a networked world, collaboration is seen globally as a growing imperative, and a valued knowledge and disposition set for students to learn at school. To do this effectively it is noted that as teachers we need to "practice what we preach" (Coke, 2005), and for it to be modelled within school settings.

However teacher collaboration suffers from being a slightly amorphous concept, at times the subject of ambiguous interpretation and vague terminology (Kelchtermans, 2006; Vangrieken, Dochy, Raes, & Kyndt, 2015). In a school context for example collaboration can relate to departmental teams, year level syndicates, Professional Learning Communities, communities of practice, mentoring, peer coaching, collaborative action research, and data teams. Furthermore, constructs of team-teaching, as spatially specific and located forms of collaboration, have been variously termed co-teaching, coteaching, collaborative teaching and cooperative teaching. Consequently an investigation of teacher collaboration presents us with an example of what Meyer (2003) notes as "troublesome language" to navigate through.

Defining collaboration

In defining collaboration (Gray, 1989) describes it as, "a process through which parties who see different aspects of a problem can constructively explore their differences and search for solutions that go beyond their own limited vision of what is possible" (p. 5). This essential action forms around the belief that two or more entities come together in order to achieve something that they could not accomplish on their own. Intentionality and purposefulness are critical themes (Gajda & Koliba, 2007).

This forms a key distinction - collaboration is a step beyond cooperation, where participants dissect a task and combine their work into the final outcomes (Little, 1990; Peterson, 1991). It is also a step beyond coordination where independent participants align activities for mutual benefit. (Gajda, 2004; Peterson, 1991). This is an important distinction to make, a useful lens through which to investigate collaborative teacher contexts, and one through the literature that raises three critical points when considering MLE. To what extent is practice actually collaborative? When does it occur? Where does it occur?

Collaboration?

One of the tensions around teacher collaboration is centred on the authenticity and effectiveness of the collaborative process. An exploration of the literature highlights that much of what has been taken as collaboration has been formed around the notion of collegiality instead, with collegiality focused on the nature of relationships between teachers, rather than the activities they are engaged in (Barth, 1990; Datnow, 2011; Hargreaves, 1994; Kelchtermans, 2006). Although these are clearly not mutually exclusive, it prompts consideration of the formation of collaborative teacher groupings and aligned expectations. Some teachers may see a shift into collaborative settings as a positive one, whereas for some the move will be the result of a series of push-factors (Vangrieken et al., 2015). It is not necessarily voluntary.

In Hargreaves' (1994) view collaboration should be, "spontaneous, voluntary, development-oriented, pervasive across time and space, and unpredictable" (p. 193) He reflects that more administratively regulated collaboration can lead to what he terms 'contrived collegiality'. However as Datnow (2011) notes although such arrangements may provide a necessary starting point, with continual checking on collaborative processes, more contrived situations may in turn shift towards more genuine collaborative activities. Which raises the question when investigating teacher collaboration in MLEs: to what extent are indicators of collaboration actually present?

Time to collaborate

Secondly, if collaboration is viewed as collectively achieving something not possible alone, then negotiation and dialogue underpin the co-construction of meaning that allows people to journey beyond an individual and therefore more limited view of what is possible (Game & Metcalfe, 2009; Gray, 1989; Roth, Roth, & Zimmermann, 2002). Building on Vygotsky's social constructivist theory Roschelle (1992) notes that this convergence is achieved through "cycles of displaying, confirming and repairing shared meanings" (p. 237) and forms the 'crux' of collaboration. These shared meaning are in turn subject to review and revision, emphasising that collaboration is as much a journey as a destination (Gajda, 2004). This itself will take time.

In the long term there is a need to engage as a team and come to shared meanings, agreements and understandings about goals, processes and structures. Also to develop ongoing temporal practices that allow for time to meet, to problem-solve, to plan and to reflect (Campbell et al., 2013). It requires an ongoing review process, in order to negotiate a way through previously contested spaces (Cherry, 2005). Consequently finding the time has commonly been highlighted as a barrier to effective collaboration in team situations (Kelchtermans, 2006). Not that purely having time to meet is sufficient. As Gajda and Koliba (2007) note teachers need to learn how best to use the time that they have. Consequently schools and teacher teams may develop their own systems, structures and efficiencies relevant to their own context. Which raises the question: what are the systems and structures that underpin pedagogical collaboration, and how do teams of teachers develop them?

A third tension relates to the 'where' of teacher collaboration, and draws attention to the relative spatial disconnect between activity and space.

Teacher collaboration and space

In locating teacher collaboration it is frequently noted as an activity that has happened 'elsewhere'. Both temporally as well as geographically the work that teachers have done together has often been dislocated from the primary interface of teaching and learning. To a large extent therefore it has constituted a 'visited' activity, something that teachers have left their classrooms to do. Forte and Flores (2013) for example, in an examination of collaboration in the context of professional development, found that teachers talked of working collaboratively but generally did so in out of classroom settings, where conversation related to extra-curricular themes rather than focusing on in-classroom pedagogy. Spatially this is common. The faculty office, the staffroom, and the team meeting have often formed the preferred sites for collaborative activities (McGregor, 2003), with much of the work that teachers do remaining on their own.

In contrast MLE spaces frequently signal a spatial intentionality for teacher collaboration, and within them a design preference for teacher teams working together (Gislason, 2009). Although enjoying something of a renaissance, as a pedagogical approach teaching together is nothing new. However references to such approaches have seen limited exposure in schools since open-plan schools lost their appeal in the early 1980s (Cleveland & Woodman, 2009). Much of the team teaching literature instead is situated within the context of Special Education. Accordingly though it only infrequently acknowledges the spatial settings of such arrangements.

As a corollary to this Clandinin and Connelly (1996) observed, teacher professional knowledge landscapes, formed at the junction between practice and theory, have often delineated between classroom as safe, private spaces, "where teachers are free to live stories of practice" (p. 25), and outside the classroom spaces as being professional, communal and at times policy spaces. The danger here is that such 'secret' classroom practice is viewed as perennially negative and slightly subversive. Yet there is nothing to say that highly innovative, but contemporaneously isolated practice could not be taking place within. If collaboration is a desired outcome, then what place still the individual?

Towards 'closeness'

The shift to MLEs has brought with it a counter-narrative to classroom spaces that, as Campbell (2013) notes, have historically privileged levels of (in)visibility, privatisation, autonomy and territorialisation over teacher collaboration. Instead the collective and deprivatised are presently being prioritised, creating new conceptualisations of teacher assemblages (Dovey, 2010) within new and existing schools.

Bringing teachers together may in turn lead to consideration of alternate proximities (Knoben & Oerlemans, 2006), as teachers learn to work alongside each other. With that in mind, Barrett & Zhang's (2009) description of teacher and student occupation of a new school building as a 'Finished beginning' is particularly apt. It reflects the possible emergence of models of teacher collaboration as well as evolving complexities and contextualities. The extent to which the potential of teacher collaboration, coupled with the affordances of the space, can be realised becomes reliant on how well teachers navigate not only the new space but also critically negotiate the relationships within it.

Collaboration is by definition an aspatial concept, bounded less by space, and more by time and relationships. But in the context of many Modern Learning Environments in primary schools, spatially it is a critically connected one. It lies at the heart of a significant shift from the privacy and autonomy afforded by a traditional classroom towards teachers working together in-situ. The extent to which the potential of the collaboration, coupled with the affordances of the space, can be realised becomes reliant on how well teachers navigate not only the new space but also critically negotiate the relationships within it (Alterator & Deed, 2013; Campbell et al., 2013). How therefore might you look at teacher 'closeness' in collaborative MLE spaces?

Proximity as theoretical framework

In understanding teacher collaboration in MLEs the concept of proximity may provide a useful focusing lens through which to investigate emerging issues. Although 'proximity' is more ordinarily used to denote geographical locality and closeness, it has also been used to describe non-spatial constructs in the context of inter-organisational collaboration (Knoben & Oerlemans, 2006). By taking a multi-dimensional view of proximity to describe, 'being close to something

measured on a certain dimension', (p. 71) Knoben and Oerlemans expand beyond the spatial and distinguish between alternate notions of proximity: cultural, organisational, social, and technological, to explore the relative distance between organisations working together. This could usefully be applied on smaller scale to groups of teachers working together in a MLE.

Knoben and Oerlemans' view that proximity is often seen as an important pre-condition for successful collaboration implies that different types of proximity support and facilitate the performance of organisations in different ways. In the case of teachers working together in MLEs therefore, the non-spatial aspects of proximity become of interest. Teachers in such environments are already cohabiting a physical space, and are by default geographically proximal. Yet this spatial locality may in turn lead to the identification of issues and challenges that in turn correspond to adjacent proximities. So to better understand some of the principles underlying effective collaboration for teachers in MLEs, consideration of alternate proximities may provide some interesting reflections, and questions for further investigation.

Adapting the framework developed by Knoben and Oerlemans, in order to investigate the dimensions of proximity at a MLE teacher team level there are a number of relevant dimensions that can be extrapolated (See Figure 1):

Geographical Proximity: is identified as spatial 'closeness', with the importance here of investigating how locality, and relative distance intersects with space, deprivitisation, as well as interactions - both planned and serendipitous.
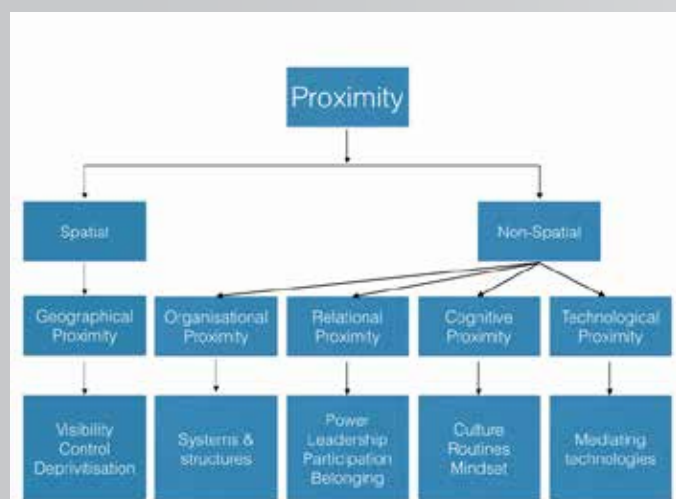
FIGURE 1 - *Spatial and non-spatial proximities (Adapted from Knoben & Oerlemans)*

Organisational Proximity: is interpreted here to describe the systems and structures that underpin teacher collaboration - characteristics of rules, routines and behaviours.

Relational Proximity: is used to describe the relative level of social interactions across the network of relationships. It refers to the structural equivalence of actors across the team organisation, and provides room to explore issues of power, participation, mutuality, and belonging.

Cognitive Proximity: is based on understanding shared routines, cultures, values and ways of working. This can be used to investigate norms and teacher mindset around teacher collaboration, rationales behind 'why we do what we do', how this is thought about, and communicated.

Technological Proximity: is interpreted here as describing mediating technologies used in the creation of new knowledge, and can be used to frame understandings of what and how teachers learn from each other.

In constructing a model that separates proximities into the spatial and the non-spatial I am cognisant of the potential of creating a socio-spatial divide. Instead acknowledging the inextricable connections between the relational and space, as opposed to the space providing simply a container for interactions (Massey, 2005).

Methodology

The study is being completed in three phases. The first phase consists of interviews with selected educational leaders across New Zealand to identify key themes as well as potential research sites. This builds on the notion of *Reputational Site Selection* (Goetz & LeCompte, 1984; LeCompte & Schensul, 2010), as well as the practice of identifying and examining practice in exemplar learning environments (Blackmore et al., 2010; OECD, 2013). Subsequently a set of snapshot case studies will be conducted in six primary schools, with data collected through observations, semi-structured interviews with principals, and focus groups of teachers and students. Three of these schools will then be selected for in-depth case studies (Stake, 1995), with data collected through field journal observations, interviews and documentation, and analysed using thematic narrative analysis (Riessman, 2008).

The Phase One research discussed here consisted of semi-structured interviews with a number of key participants. The study began with six participants, selected from the researcher's personal professional network. As part of the interview they were asked to recommend other participants in a 'snowball' sample (Bryman, 2012). In addition participants were asked to recommend relevant research sites. These needed to be MLE sites as well as schools where collaborative practice was viewed as successful. This process was continued, until theoretical saturation (Bryman, 2012) was reached in terms of issues raised, as well as sufficient sites had been recommended and repeated.

The use of semi-structured interviews meant that although as a researcher, I had approached participants with a number of key themes and apriori concepts that I wanted to address there was space within the interview for participants to pay particular attention to issues that were important to them.

Emerging themes

Although early on in the data collection and analysis stage of the research, initial indications suggest a number of emerging trends and themes. While these do not represent concrete findings they do assist in directing the project and in iterating into the next phase.

Data analysis was undertaken using narrative analysis methods (Riessman, 2008). Accordingly I have avoided taking 'soundbites' from multiple data sources and recombining them. Instead choosing here to work from a single source. Examples are selected from one interviewee, Principal of Riverside Primary, a relatively new school Year 1-8 school with open and collaborative MLEs.

The data reflects that while there are some differences in personal rationale behind a collaborative teaching approach within new spatial settings, there is clarity in the value seen in the collaboration. Teacher collaboration is seen as a good thing in theory, although not necessarily an easy thing to enact. Instead it is viewed as something that will present new and evolving challenges for teachers, leaders and schools, along with the potential for sustained professional change. What does it look like? How do you manage and coordinate time? What works? What happens when it doesn't?

As the Principal describes:

> *For me, I think it's a better representation of the nature of the world that our kids are going to be entering. 'Cause we can't define that to any degree of specificity the way, you know, generations before us could. Dare I say it, even my generation. But what we do know that it's going to be quite a social type world they're going to inhabit, that skills around getting on with others, being able to compromise, being able to negotiate, being able to think differently, being able to work interdependently, those sorts of things are going to be critical. You can't do that if you're working in isolation. You can't do that if you're not modelling it at an adult level.*

The Principal commented on the affordance of spatial visibility having an impact on professional as well as student learning. The notion that learning was ongoing, in-situ, spontaneous and highly contextually relevant. But this was accompanied by a need for the school's culture to recognise and be responsive to that. Establishing a norm where 'noticing' and feedback was normalised was recognised as a challenging one, but a critical dimension (Campbell et al., 2013). This finds real congruence in the "practice what we preach" belief underpinning one rationale behind collaborative spaces. However the Principal later raises an issue that leads to consideration of both relational and cognitive alignment between teachers.

> *So I'll give you a specific example. A team leader, (Teacher B) , might walk past one of the teachers teaching Reading and click to something in their delivery of a guided reading lesson that she's not comfortable with. And because they're in that open collaborative space, she sees it, observes it very quickly, can choose how she wants to tackle that…'Cause it surfaces that stuff very quickly, which would never happen in a single-cell experience…How do you address issues that occur that can't be addressed in front of kids? So, you know… you hear something communicated that's not accurate, needs to be brought up. But you don't do that in front of the kids. It's not appropriate. How do you flag that discussion there and then? Or should you flag it there and then? What's the procedure or the practice that sits around that?*

Organisationally where does the line sit? What is it you do model as a teacher and what do you leave to another time? Much of this is tied to shared beliefs and practices but needs to be skilfully negotiated and navigated as a team. It questions what stays in the public domain and what shifts into the private? In doing so it illuminates one example of the need for teachers to explore the potentially contested white space' that falls between existing practices and procedures (Cherry, 2005). A shift into the public domain not only exposes practice but also challenges the levels of autonomy teachers have enjoyed in traditional settings:

> *You know, if we're honest, in a single-cell experience, if you wanted to have 5 minutes sitting down or, I don't know, read the story for a bit longer or carry on that class discussion for a little bit longer or spend another few minutes with that guided reading group, that was a conversation you had internally and made a decision and you acted on it. Now, I'm not saying you can't do that in a collaborative space, but it's not necessarily your decision to make. Or does someone have that decision-making power? Or if you want to do that, how do you actually work through that process?*

Here the narrative of the built environment, as collaborative space may find a discord with the narrative of the teachers that inhabit it in terms of teacher beliefs, and previously regularised, routine, or ingrained practices. The need to negotiate time and to work flexibly becomes an important factor, not only in terms of time with teachers but also time with students (Alterator & Deed, 2013).

Conclusion

The terrain of teacher collaboration within Modern Learning Environments is somewhat littered with slightly fuzzy nomenclature, broad interpretation and semantic diversions. Consequently what is taken to mean collaboration in one setting may not easily translate to another, instead reflecting collegiality and coordination, rather than true collaboration. It is reflective of the deep complexity seen at the confluence of pedagogical practice, spatial settings, and professional change.

In contrast to the energy expended in exploring new spatial settings, the issues that occupy teachers and leaders, certainly on first occupation often appear to be less concerned with some of the nuances of space, and more concerned with the negotiation and co-construction of relational, technological and organisational elements. Effective teacher collaboration in MLEs takes time, negotiation and ongoing systemic support, and is shaped and reshaped over time. While geographical proximity may present opportunities for teachers, it also presents complex challenges at a professional, social, cultural and cognitive level.

The extent to which the provision of new learning spaces and new teacher settings in turn provide a catalyst for collaborative approaches to impact on students is largely contingent on the capacity of teachers to work together. Understanding underpinning beliefs, principles and practice of collaborative teacher practice in MLEs is viewed therefore as an important step in the process. The proposed proximity framework may provide a focusing lens through which to investigate these emerging issues.

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Mediating contemporary learning through spatial change: An account of 'library-as-experimental-space'

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Changing a school from traditional to contemporary learning is challenging. This paper presents an empirically researched account of how one primary school, struggling to bring about a more contemporary learning environment, 'reimagined the geography of learning' (Mulcahy, 2015) through redesigning the library as an experimental learning space. Altering the image of schooling by creating a visible, alternative learning space served to rehearse the more radical transformation to come. The purpose of this paper is twofold. Firstly it explores the network effects and power relations (Leander, Phillips, & Taylor, 2010; McGregor, 2004) that generated the library-as-experimental-space and the role it played in the larger story of transformation at the school. Secondly it foregrounds the potential of poststructural, sociomaterial research approaches (Fenwick, Edwards, & Sawchuk, 2011; Latour, 2005; Law, 2002), for revealing detailed and nuanced data that may be missed in traditional evaluation methodologies.

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Caroline has been working in primary education for twenty-six years, the last seven years as a principal. Caroline is a current PhD candidate at MGSE researching the innovative learning environments and pedagogic practices that emerged through the Building the Education Revolution. Caroline's research takes the form of a policy study - policy-as-practice rather than policy as implementation. Methodologically it is an ethnographic case study using photographic and interview data collected in Catholic primary schools with reputations for innovative design and contemporary pedagogy. Using a socio-material approach she seeks to give attention to the materiality of the learning environment - people, furnishings, objects, space and technologies.

Introduction

Publications making a connection between pedagogies and learning space design, although not new, have grown markedly over the past decade and influenced changes in many schools and other places of learning in Australia and worldwide (Cleveland, 2015). But, as Mary Featherstone reminds us, 'transforming a school from traditional to 'contemporary' learning is challenging' (Featherstone, 2012, p. 93). How do schools set about transforming the learning environment spatially and pedagogically? What influences their reforms? This paper presents an account of one school's journey to create a more contemporary learning environment. Through reconfiguring the library, a space of tension and experimentation grew up affording alternatives to prevailing school practices.

A sociomaterial analytic

Theoretically, this paper challenges the sometimes taken-for-granted assumption that material things such as learning spaces simply frame and support human activity but are not taken seriously as active participants in learning. In contrast, the sociomaterial sensibility foregrounds the understanding that educational change is a matter of complex social AND material relations shifting and performing everyday knowledge-building practices. Advancing the idea that the social, material and textual are inherently inseparable and co-constitutive, this paper posits the possibility that unanticipated entities may emerge as agents or mediators of change[1]. Informed by Deleuze and Guattari's assemblage theory (Deleuze & Guattari, 1988) and Actor Network Theory (Latour, 2005; Law, 2009), the assumption carried into the study is that an object of analysis such as a 'new generation learning environment' is not naturally given in advance but emerges with and is enacted in practice. The sociomaterial approach understands that any focus on objects is located in extended spatial and temporal relations and research must attend to the boundary work through which entities become defined (Orlikowski & Scott, 2008).

Many mediators can remain invisible when research begins with standard categories of analysis and human-centred framings. However, through a sociomaterial approach, the understanding of learning environment is one that is continually enacted in a constitutive entanglement of technologies, policies, pedagogies, teachers, learners, furniture, resources etc. It does not presume the existence of independent entities prior to practice (Faulkner & Runde, 2012).

In what follows, first I briefly explain the policy theorizing environment influencing new learning environments in schools. I outline three moves of policy theorizing – policy implementation, policy enactment, and a sociomaterial rendering of policy enactment – and articulate how policy can be understood as mobilized and enacted in school settings. Next I examine the research school setting and outline the methods I used to collect the data. The empirical data is then worked using an assemblage analytic as I present a closeup account of the work of 'library-as-experimental-space' as a mediator of change, bringing to light the materiality that is often invisible in both policy and practice. I conclude by indicating the material, physical and discursive work that the library-as-experimentalspace does at the research school. This paper seeks also to raise questions about the contribution that sociomaterial approaches can make to educational research.

Policy theorizing

In Australia, as in many other countries, school reforms that seek to change from traditional classrooms to new generation learning environments are underway. Policy documents both internationally (DfES, 2002, 2003; OECD,

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1   For Latour (2005) a 'mediator' is an 'actor' – any entity that creates opportunities for other entities to act as mediators – a mediator makes other mediators *do* things. The more mediators the stronger and more stable the assemblage.

2006) and in Australia (MCEETYA, 2008) identify new spatial designs and structures as critical for transforming schooling. In the Catholic Education Office, Melbourne, policy documents (CEOM, 2009a, 2009b) denote well-designed, flexible spaces as essential for contemporary learning which is characterized as collaborative, learner-centred and connected through digital technologies. Such policy discourses strive to set a direction by stating preferred pedagogical and spatial practices for schools. These discourses state a clear connection between the quality of the built environment and learning outcomes; for instance that a 21st Century learning environment supports the development of 21st Century skills such as collaboration, communication and critical thinking (see for example, CEOM, 2009b). However, when Blackmore, Aranda, Bateman, Loughlin, and O'Mara (2011) undertook a review of over 700 documents, they found that the connection was unsubstantiated in empirically researched studies.

Much policy making and policy research takes a techno-rational approach based on wellestablished and replicable methods intended to problematize and solve education problems (Webb & Gulson, 2012, 2015). A common outcome of the techno-rational policy approach is a kind of schism between terms such as 'old' and 'new', 'traditional' and 'contemporary' or 'innovative', and 'classroom' and 'learning environment' (DEECD, 2009; DfES, 2002; MCEETYA, 2008; OECD, 2006). Another outcome is the portrayal of learning spaces as static, preexisting surroundings or containers for social actors to inhabit but they are not seen as playing any constitutive role in learning or other institutional activity (Mulcahy, 2014). Moving beyond the techno-rational policy approach, an emerging shift in policy research is enactment theorizing (Ball, Maguire, & Braun, 2012; Mulcahy, 2014). Enactment theorizing 'resists the tendency of policy science to abstract problems from their relational settings by insisting that the problem can only be understood in the complexity of those relations' (Grace, 1995, p. 3). However, an enacting approach that views policy as interpreted and translated by policy actors maintains a separation between policy text and policy actor and places policy outside of, and preeminent to, practice (Mulcahy, 2014).

A sociomaterial rendering of policy enactment challenges the separation of text and actor by theorizing policy as 'constantly changing; indeed, constantly emerging' (Webb & Gulson, 2015, p. 169) in heterogeneous practices, rather than already

articulated in texts to be interpreted by social actors (Mulcahy, 2014). Such a rendering of policy is 'fully performative' – that is performed again and again. Policy emerges in indeterminate ways with the many diverse actions of social and material mediators. Emergence is a significant aspect of sociomaterial approaches to policy analysis in which 'any changes we might describe as policy – new ideas, innovations, changes in behavior, transformations – emerge through the effects of relational interactions …' (Fenwick & Edwards, 2011, p. 712). In a fully performative rendering of policy, spaces [and time] are fluid and ephemeral, formed and deformed with the ebb and flow of each pedagogical move. Mulcahy (2014) finds that an assemblage rendering of learning environments acknowledges that they are not spatially set and singular, but always 'in the making' (Op cit, 2015, p. 511). Like McGregor (2004) who takes spatiality to be a tool for tracing sociomaterial 'relations and patterns of power and agency' (McGregor, 2004, p. 351), this paper theorizes space as enacted at the tension between materiality and sociality.

The data being worked in this paper were collected as part of the qualitative case study for a thesis titled: 'The promise of policy: Assembling new generation learning environments in Victorian schools'[2]. The study takes a broad look at policies in relation to contemporary learning environments (to be referred to as NGLEs in this paper). It asks questions about how policies influence the architectural design and pedagogic practices in
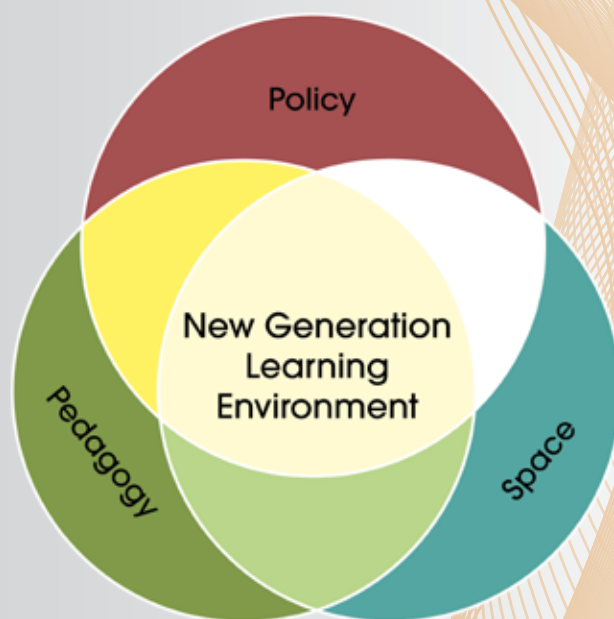

FIGURE 1 – *intra-connecting entities of policy-pedagogy-space*

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[2] This project began as a Master of Philosophy which was converted and confirmed as a PhD study in May 2015.

NGLEs in Victorian schools, and how such NGLEs can be understood as policy artefacts. The study's significance derives from its potential to provide better understandings of the take-up of policy in relation to NGLEs, which are both under-researched and under-theorized (Blackmore et al., 2011; Fisher, 2000). To date, there are few empirical studies into how these policies are taken up (or not) in practice in these newly built learning environments and, given the recent substantial Australian Federal government investment in school architecture and redesign (the Building the Education Revolution scheme 2009-2012 – BER), such research is timely.

Figure 1 shows three 'intra-connecting' entities which are the focus of the thesis: policy-pedagogy space[3]. I propose that the NGLE assemblage emerges through complex intra-connecting relations between multiple social and material actors or mediators. A sociomaterial sensibility places the focus on the materiality of the learning environment, without privileging human actors (Fenwick, Nerland, & Jensen, 2012; Fox, 2011).

Empirical setting and data collection methods

The school where the data was collected is a Catholic primary school in suburban Melbourne. Built in 1936 as a 2-storey brick building with long corridors and closed classrooms, it had seen few structural changes since that time apart from updating desks to tables and purchasing learning resources. Until the leaders began to research contemporary pedagogies in 2006, teacher practices were still fairly traditional and the physical resources and classrooms were quite dilapidated. It was built at a time when school buildings were taken-for-granted, container-like structures reflecting what some call the 'imagined geography' of schooling (Leander et al., 2010, p. 329). But by the early 2000s, new discourses were emerging in education and making their way into schools through publications and professional learning programs committed to (re)engaging students in learning (Hill et al., 2002), using contemporary tools, and creating learning communities (CEOM, 2009a). Such discursive changes can be seen as providing a platform for transformational change inasmuch as schools like this one were being drawn into global,

national and systemic projects of radical reform (Whyte & Cardellino, 2010).

Phase 1 data collection from which the data for this paper emerged involved researching in two Catholic primary schools that have a reputation for innovative architectural designs and contemporary practices . My interest is in exploring the processes through which the schools brought about changed practices. I visited the schools and spent two hours taking photographs and field notes, noting the movements of students and teachers in one learning area. These observations were followed up by paired interviews with two leaders, two teachers and two students. The data presented below is taken from the interview with two school leaders at one of the schools.

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The school leaders trace the start of their journey of change to a wide-ranging school review which showed that their students were:

> *… motivated to learn, but the learning was not engaging for them …*

They applied to become a research school for the Catholic Education Office of Melbourne's Contemporary Learning Research Project (CLRP). As this leader expressed:

> *So we signed up to that, and we were far from being a contemporary learning environment …*

This leader recalls the tension between the discourses around contemporary learning and the state of the learning environment at the school. Their task seemed enormous as this question asked by one of the school leaders reveals:

> *… well how can we do this in such a dilapidated school?*

School reform policies do not simply travel from policy makers to school contexts but are mutually constitutive in complex sociomaterial relationships. Nespor (2002) highlights the difficulty of conceiving 'reform' and 'context' as separate spheres working to support, or even to undermine, one another. Rather, reforms and contexts mutually constitute one another as their discourses shift across multiple networks of 'advocacy and practice' (Nespor, 2002, p. 365). Reforms such as the contemporary learning discourses and contexts such as the school are not separate arenas but constitute 'circulating entities'

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3   Inspired by Karen Barad's notion of 'intra-action' (Barad, 2003) which captures the social and material entanglement of reality, I use 'intra-connecting' to indicate that entities, such as pedagogy, space and policy are not pre-givens but are 'intra-active with' each other, simultaneously constituting and being constituted in practice.

(Latour, 2005, p. 233) producing a pre-conscious space that both strategically and politically works for some, perhaps unformed, policy outcomes (Webb & Gulson, 2012). Webb and Gulson (2012) describe this pre-conscious space as the space between policy sensing and policy enactment.

Taking note of how identities are inscribed and enacted reveals patterns of power relations as entities act on each other, seeking to enroll each other as mediators into networks of practices (Fenwick & Edwards, 2010). School leaders become policy mediators, links in a chain of associations and potential sources of innovation and change. The interview data brings to the fore patterns of power as school leaders work to enroll mediators by disrupting prevailing material, social and discursive practices and challenging accepted patterns of behavior of the school. However, the data also reveal the contrasting power of teaching practices at the school which had become durable and static continually inscribing and re-inscribing teacher identities, and indeed student identities as this leader recalls the effect of bringing back new ideas from their research:

> So we went along and did a lot of research and brought that back, but it was met with a lot of resistance …

The research school set out to change the learning environment through reconfiguring the physical space. But rather than starting with the classrooms, the library was chosen as a public space through which a visible alternative environment could be created for teachers and students to trial and showcase contemporary pedagogical practices. However, reconfiguring the library produced further tensions and resistances when it involved throwing out old resources. As this leader recalls they were:

> "… really throwing out a lot of the resources, which was really heartbreaking for a lot of staff who'd been here a long time, but they couldn't see the reason we were doing it was that we needed to make it a contemporary environment where the children could have access to relevant information, and that included embracing ICT …"

Removing resources that had for so long been part of the materiality of the school makes visible the hidden network of material relationships between the teacher and learning resources. McGregor (2004) drew on her own research of the materiality

of schooling, and that of Lawn and Grosvenor's (2001) study of stored school resources that had long fallen into disuse, to explore the network of teacher-resources. McGregor states: '… material technologies … are inextricably linked with the pedagogic practices that constitute it, and the prevailing view of what counts as knowledge' (McGregor, 2004, p. 248-249). In the research school the older teaching resources stored in the library evoke a time when teachers produced their own tools for learning, when material resources were few and the school had little funding for new technologies (Lawn & Grosvenor, 2001). Now in the 21st Century world where digital technologies are changing the way we live, work and learn (OECD, 2006) once valued artefacts had become clutter.

Sociomateriality posits that change involves a 'complex interplay of social and material relations' (Fenwick et al., 2011, p. 172) in which social and material mediators emerge and seek to enroll other entities as mediators in the change network.

The data reveal how school leaders seek to materialize policy through reconfiguring the learning environment, disrupting established, taken-for-granted beliefs about school and taken-for-granted teaching practices. As this leader describes:

> "We put in sliding doors that opened out onto a lovely little courtyard area … so really embracing the outdoors as well as the indoors as learning environments. We ripped out the old librarian's office and we turned that into a large ICT area. So the room was made up of a gathering space, a beautiful corner, you know with nice furniture, contemporary, bright, we painted it white, uncluttered, we opened the blinds up, we let the light come in and all of a sudden … it was met with a lot of resistance from staff, but all of a sudden the kids were dragging staff in – can we go back in there? Can we go back in there?"

Figure 2 shows some of the intra-connecting mediators, human and non-human, that participate in the library-as-experimental-space assemblage. Latour (2005) explains that every mediator along a chain "makes other mediators *do* things" (Op cit, 2005, p. 217). The old library, acted upon and made to act by social and material mediators, emerges as a 'library-as-experimental-space'. Some mediators which had been invisible aspects of the learning environment are made visible; these include the blinds, the light, the outdoors, comfort

and the kids. Other once powerful entities are challenged and silenced; these are the Library, old resources, the librarian and teacher resistance. The changed space of the library-as-experimental-space 'provokes disequilibrium' (Willis, Bland, Hughes, & Burns, 2013, p. 5) and necessitates thinking. It creates resistances by challenging the accepted order of things and opens up a space for new ways of understanding learning environments.

The library-as-experimental-space creates a space for different teaching practices to reinscribe teacher identities by marking a move away from individual practices to practices that are collectively planned, shared and continually produced in processes of flow. In Deleuzean philosophy the library-as-experimental-space presents as lines of flight – undetermined movements of multiple material entities rather than a single solution. Lines of flight are processes of continual becoming along lines which already exist and which continue through processes of flowing and fleeing in the de-re-territorialisation of the library-as-experimental-space assemblage (Deleuze & Guattari, 1988).

Spatial metaphors of threshold and liminality emerge with the library-as-experimental space. The threshold opens up as a portal to other worlds bringing multiplicity and troubling beliefs, but it has no function until it is connected to other spaces (Jackson & Mazzei, 2012). Intra-connecting with other data, other places, texts, materials and people, the threshold opens as a liminal space – a place of resistance and change. Stepping across the threshold is encountering the liminal, in-between space of tension and continual change permitting new and previously inaccessible ways of thinking

and becoming (Land, Rattray, & Vivian, 2014). The liminal emerges with the library-as-experimental-space, unsettling conventional ways of thinking and transforming meanings and identities.

Learning happens indoors and outdoors

FIGURE 2 - *the library-as-experimental-space - a web of multiple intra-connections enrolling other mediators into the assemblage*

Some teacher-student relationships are changing

Resources are distributed around the school

ICT is everywhere

and how they work, spaces are now bright and light, and resources once stored in the library are distributed around the school.

The BER scheme funded the whole school physical transformation that works to create the contemporary learning environments that can be seen in these photos[4].

This paper and the PhD study contributes to learning environment research through its deployment of a sociomaterial research approach. Such an approach de-centres human intentions and human purposes from processes of change allowing other mediators to emerge as change agents. This approach is open to multiple possibilities – researchers are aware that data reveals as much as it silences. Such research opens a space to reveal complexity and counter-narratives in the micro-politics of change processes in schools.

Conclusion

The library-as-experimental-space emerged as a mediator of change at the research school. It worked in three ways. It worked discursively to dissolve and redefine meanings. It worked physically to make visible alternatives possible. And it worked socially to reinscribe teacher and student identities. Experimenting in education is messy, unpredictable work. It is uncertain, non-linear and undetermined. But it allows teachers and students to trial and enact different material and pedagogical practices. Perhaps more importantly, it places the everyday practices of teachers and students at the centre of pedagogical and spatial change.

When I visited the school in 2014 to collect data for the research, I was taken on a tour by the leaders. The whole school has been physically and pedagogically changed from the way it was described to me in the interview. Learning environments are more learner-centred, relationships between teachers and students are changing, students have choices about where

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4   The photos were taken as part of the data collected at the research school. Ethics approval for the project was gained from both The University of Melbourne and the Catholic Education Office of Melbourne. Students' parents and teachers depicted signed permission forms.

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Embedded intervention programs can make a difference to CIM

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Australian and International research has documented the decline in community involvement and connectedness over recent decades. Associated with this decline is the decline in children's independence, particularly in the extent to which children are allowed to explore the external environment. Children's Independent Mobility (CIM) is a measure of the level of a child's freedom to explore and move about his or her local neighbourhood without direct adult supervision. This paper presents the results of a study of the effectiveness of 3 intervention programs to change travel behaviours of children to and from school in 26 Catholic primary schools, in a range of urban and regional settings in Victoria. Using pre and post intervention surveys with 1600 students, and their parents, and interviews with principals of the schools, it investigated how social capital impacted the effectiveness of these travel behaviour programs. The key finding was that the degree of social connectedness of the school and the individual, did impact on the effectiveness of the intervention programs. The interventions themselves were not effective in influencing change in travel behaviours without being embedded in a supportive school culture. These understandings can create pathways that deliver genuine opportunities for schools to be more outward-facing, and for communities to regain a measure of social connectedness.

Pat Love

Pat has worked in Catholic education for over 30 years, firstly as a teacher, then in administration performing the role of Manager for Planning over the last 10 years. He has completed the Master of Urban Planning at the University of Melbourne in 1998. He has had a passion for urban planning that encourages walking and cycling, and the use of public transport. He believes that the best urban planning provides both children and adults an option to the use of the automobile, which makes our streets and neighbourhoods safer, creates networks of connected people in a physical and social sense, enhances communities, and builds social capital.

Introduction

Children's Independent Mobility (CIM) can be defined as a measure of the level of a child's freedom to explore and move about his or her local neighbourhood without direct adult supervision (Hillman et al., 1990). The modes of travel that allow children to move independently are restr icted to walking, cycling and public transport. In the recent ABC Life Series video documentary Life at 9, the program's creators focus on the sweeping changes to late childhood, particularly how children spend their time (Peedom, 2014). The program looks at how this impacts on their independence and creativity, both indicators of success in later life. In the introduction to the section on independence, the narrator says

"Parents are ultimately the gatekeepers of their children's independence. So at 9, it is as much about parent's ability to let go as it is about children's ability to embrace it. It is essential to allow children to be responsible and gain responsibility. At some point you grow up. It doesn't just arrive in a box on your birthday. ....At 9, how much independence will give our kids the best chance in life and how much they do get?"

The authors of the program focussed on the opportunities that children today have to learn to manage risks they will face. Of 10,000 children in the longitudinal study, less than 10% get themselves up and ready for school without adult supervision, and less than half do household chores. Only one quarter of the children walk to school whereas two thirds of their own parents walked to school. What has changed in a generation?

In a small sample of nine children in the video, none of them are allowed to roam their neighbourhood, and none of the children felt they could walk to the shops and buy something. The program concluded that what stopped them were the heightened fears of risk and dangers to their children. Most children are driven everywhere, and are bombarded with messages of traffic and stranger danger. In a small experiment with those nine children, only 2 were able to walk to their closest neighbourhood shop to buy an ice-cream. What stopped the others were

described as their own fear, the traffic, and lack of a nearby neighbourhood shop. This situation is evolving, and many factors are responsible for it, including the parent's beliefs and perceptions, the child and their competency, and the fabric of our built environments.

This project set out to investigate these issues and others that confronted children in our Catholic schools when considering their independent mobility, particularly as it related to the trips to and from school. It investigated the state of children's independent mobility (CIM) in 26 Catholic primary schools and the role that social capital plays in enhancing the effectiveness of three behaviour change programs to change the level of CIM in those schools. There were three phases of my research:

1. A quantitative survey of children and parents at baseline
2. A survey of children and principals post-intervention
3. A qualitative phase involving a structured interview with principals or school leaders regarding the implementation of the programs and their effectiveness.

The chapter provides an overview of the findings then discusses it in relation to the research questions underlying the study:

1. What is the influence of a range of variables such as social capital and urban environment on the independent mobility of students in Catholic schools at baseline?
2. What programs are more effective in increasing children's independent mobility to Catholic primary schools in Victoria?
3. What influence does the level of social capital of the school and of the families have when predicting the effectiveness of programs to change behaviours?
4. What are the policies that Catholic school communities may require to successfully encourage CIM in the future?

Some definitions

The key concept is that of social capital. I have used a definition of Lewis, who defined social capital as a multi-level concept that encompasses the micro, meso and macro levels, which all interact with each other (Lewis, 2010). Social capital takes time to accumulate. The benefits may flow to groups and even whole societies, as long as the focus of analysis is on the individual acting in networks. Its consequences are neither inherently positive nor inherently negative. This is an active understanding of social capital, operating at the individual level first, and collectively second.

Lewis' definition of social capital is used in this research, and is described as "social connectedness" or just "connectedness". It includes this key aspect of action by individuals in networks, to make a resource available or active, which takes time to accumulate. Social capital is relational, and is not a passive entity. In this understanding, trust is not social capital, but may be an outcome of actions that draw on it.

Built environment can be defined as the spaces such as buildings and streets that are deliberately constructed as well as outdoor spaces that are altered in some way by human activity (Committee on Environmental Health, 2009).

The level of CIM in Catholic schools prior to intervention and the factors that predict this

The first objective of this research was to describe the baseline level of independent mobility of children in Catholic schools in Victoria. To understand the level of IM in Catholic schools, I also explored the factors that predicted this level.

The intention behind this objective was to ascertain the difference between Catholic schools and the general level of IM in schools reported on in the research. To remind readers why this was important, Catholic schools generally require a much larger catchment in terms of households in order to enrol the same number of students as government schools. Hence distances to be travelled are longer on average compared to the same sized government school (Carlin et al., 1997; Tranter, 1993). The research investigated whether it is safe to assume that transport modes are significantly different, and whether this impacts on IM.

Levels of CIM in Catholic schools

CIM is present in the travel behaviours of a quarter of all students, who travel independently to or from school, with about half of these being fully independent both ways. This is considerably lower than levels reported in the earlier study by Tranter (Tranter, 1993). He recorded an overall level of independent mobility of 48% in the three main Catholic schools included in his study conducted in Canberra schools in July 1991. This question was one of the main reasons that prompted this research project.

Possible reasons to explain the difference between the two outcomes are the general decline in IM over the intervening 19 years in the general population. Also relevant are the small size of the sample of Catholic schools (four) in the Canberra study, and the differences in urban structure between Canberra and Melbourne. Were the schools chosen as representative of all Catholic schools in Canberra, as the 26 selected in this sample were of Melbourne Catholic schools? This research cannot answer that definitively, but the larger sample of schools selected here should give more confidence that the general level of IM measured in Catholic schools in Melbourne in 2010 is reliable.

Carlin et al. reported that the odds of six to nine year old children using active transport modes in Catholic primary schools in Perth and Melbourne in 1994 were about half those in government schools, which were measured at 35% walking and 6% cycling on the trip to school and 40% and 6% respectively for the trip home (Carlin et al., 1998). In this research, 9 to 12 year olds were measured as having walking and cycling rates of 16% and 10% respectively to school and 19% and 9% on the way home. At the conclusion of the intervention programs walking and cycling to school had changed to 14% and 12% respectively, but had increased to 21% and 12% on the way home. Consistent with that, walking rates remained about half those rates measured in Carlin's study of 1994. This was also true for Tranter's study in Canberra (1993), where walking rates in 1991 were half to a third those in government schools.

Cycling rates were generally higher for Catholic students in this study than that found by Carlin et al.(1997). A similar result was also found by Tranter (1993) for Catholic schools in Canberra, where rates were about the same as government school children. I believe this reflects the fact that students in Catholic schools have further to travel, and therefore prefer to cycle rather than walk.

Individual factors:

Age

The key outcome, CIM, is the result of its surrounding ecological niches i.e. the child's own characteristics, that of their parents and family, the school, and the neighbourhood and wider community. The key child variable is his or her age and the mode they use to travel to and from school.

The research results show that 17% of children of age 9 in Catholic schools (in year 4 predominantly) are travelling to school independently of adults, but that by age 10 and 11 they are twice as likely to be independently mobile (1.9 times and 2.3 times more likely respectively). This pattern of change is broadly consistent with other Australian studies from Tranter (1993) and Carlin et al (Carlin et al., 1997) to Hume et al (2009) and Carver and Timperio (2008). It contrasts with the study of Hillman et al (1990) in the UK, where a similar independence level was reached as an eight year old. In Australia in 2010, it was at age 10 when most children were first permitted to walk or ride independently.

The mean age at which children said they gained the licence to cross a road without an adult was 9.5 years. This falls within year 4 in most children's school life. Tranter surveyed the views of parents in 3 Catholic schools; they had higher average ages of allowing children to cross main roads alone - typically greater than 10.2 years (Tranter, 1993). Given the small sample, this is close enough to the result of this research for the two to be considered consistent.

Gender

Previous studies indicate there is a significant association between CIM and gender (Giles-Corti et al., 2011; Trapp et al., 2012; Villanueva et al., 2014; Tranter, 1993; McMillan, 2007). A higher proportion of children with independent mobility are older (age), male, etc. I have found that CIM in Catholic schools is strongly related to age and distance, but like the findings of Hume (Hume et al., 2009) and Brown (Brown et al., 2008), CIM was not related strongly to gender. The later found that gender was not a differential factor, as girls travelled independently but in a different manner to boys, frequently in groups and using public transport to travel further.
Younger children are less likely to have the confidence of parents/guardians to be able to responsibly and safely manage the traffic and other issues for a journey to and from school. Boys also seem to gain the confidence of parents earlier than girls, particularly for fully independent travel to and from school. However gender was excluded from the final regression model. It may be represented by the inclusion of mode of travel, incorporating the association of boys and cycling. This relates to the higher number of boys who prefer to ride to school compared to girls (55.2% v 44.8%), and the higher likelihood that children will ride completely independent of adults (67.6 and 69.6% of cyclists are fully independent in the journey to and from school respectively, compared to 34.1% and 30.3% of walkers to and from school).

Children's preferences and licence to travel independently outside of school and on weekends

This research does reinforce the findings of Veitch and colleagues (Veitch et al., 2007) that children generally, and specifically those 9 to 12 year olds surveyed in these Catholic schools, prefer to travel independently, or at least prefer active travel modes, rather than travel by car. The results also confirmed that Catholic school children are highly car dependent, especially in outer urban locations, which is consistent with the earlier studies by Carlin et al (Carlin et al., 1997) and Tranter (1993).

Active travel modes such as walking and cycling are natural precursors to independent mobility, with between 63% and 64% of walkers and between 79% and 80% of cyclists being independent. Only 7% of children who are driven to school walk home independently, and just 5% who are driven home, walk independently to school. This supports the conclusion that independent mobility begins with active travel modes. Kingham and Ussher in their evaluation of the Walking School Bus (Kingham & Ussher, 2007) concluded that WSB has a positive effect in that children are physically active and on the street, and therefore are more likely to graduate to independent travel than those who travel by car.

Children who hold licences to travel around independently outside of school are also strongly associated with being fully/partly independently mobile on weekends. While this sounds an obvious connection, a licence to travel is a statement about the parent's assessment that the child is competent to travel safely by themselves. It is highly likely that the same children who hold that competency assessment i.e. licence to cross busy roads, ride on main roads, and visit friends on the weekend, are also judged to be competent to walk or ride to and from school, and travel on the weekend (Curtis et

al., 2015; Veitch et al., 2007; Valentine, 1997). Those competencies are the foundation of their social capital (Malone, 2007; Chawla, 2002; Mackett, 2002; Tranter & Pawson, 2001). Giving children skills to walk the neighbourhood streets on a weekend, walking them to school or organising a walking school bus to get to school, riding with them to destinations after school, are all essential preparation for children to be independent. They do not learn this in the back seat of the car.

Social capital factors

My research has found that social capital variables were strongly associated with CIM at baseline, especially at the school level. These predictor variables include the child's perception of playing with friends in the street, and parent perception that they knew neighbours well, that it was a good place for children to grow up, and that neighbours were willing to help each other. These associations speak of strong, safe and connected communities, where people trust their neighbours, which is consistent with the literature (Putnam, 2000; Hume et al., 2009; Brown et al., 2008; Tranter, 1993).

There was a negative correlation of some parent and school principal social capital variables with CIM post-intervention, which suggests that those parents and communities who support independent mobility at times run counter to the mainstream values and possibly encounter opposition or criticism. (Gill, 2007; Valentine, 1997; Prezza et al., 2005; Nicholson, 2014; Nicholson et al., 2014) This becomes more evident in the next section when a child is changing their behaviour to a more independent mode. It is not always true that neighbours are seen as sharing their values, that neighbourhoods are places where a good lifestyle is sought by all, or indeed that all are agreed about what this means.

Post-intervention, parents that were involved in community groups frequently were strongly associated with high levels of IM in their children. This reflects a link to the critical factors of social capital or connectedness and trust in the community, as these people who join community groups are more likely to be builders of social capital than the opposite.

School community factors

As reported above, parent perceptions of their connectedness with the school community through a parent's involvement with community groups is associated with CIM post-intervention. At baseline, the schools where the principal reported that parents knew each well, and where it was not difficult to get parents involved in the school were also strongly associated with CIM. This reflects the presence of strong bonding social capital or connectedness in the community. The SES of the school is also a reasonably strong predictor of CIM. Once other factors were accounted for, lower SES was associated with higher levels of CIM.

Finally, reasons for school choice play a role in the degree of independence of children later, as evidenced by the strong association of CIM with the choice of school because it was close by or because it was the local, Catholic school. There was a negative association with the choice based on the school being a convenient location. While distance is a part of this factor, there is also a social dimension. In other words, if the parent chose the school initially because it was their local Catholic school, and therefore within a relatively short distance of home, then they were more likely to be trusting of and connected to the local community. They also are more likely to then allow the child to walk to school. This result suggests that social capital should play a role in the model of how variables interact to produce independent mobility.

Built environment factors:

Distance to school

Built environment factors were less important in Catholic schools but still influential, especially the distance a child lives from school. For the baseline cohort, the mean distance children lived from school was 2.8 km by road or 2.1 km "as the crow flies" (Euclidean). These represented almost 70% of all children. This result is generally consistent with the average distances reported in Tranter's Canberra study (1993). At the conclusion of the intervention programs, 63% of children who lived within 2.1 km of school were not independently mobile on the trip to school, and 55% were not IM on the trip home. Two kilometres is commonly considered a walkable distance for students of this age (McDonald, 2008),(SRTS, 2015) and 6 km for cyclists (SRTS, 2015). At baseline, walkers were walking on average 1.1 km to school and 1.3 km home, and cyclists were riding 1.5 km on average to school and 1.7 km home, with

a maximum of 3.8kms. Post-intervention, walkers did not change much, but cyclists were riding on average 1.9 km to and from school with the maximum distance being 7.7 kms, confirming those distances for walking and cycling. It would seem that there is considerable scope for Catholic schools to increase the percentage of students who are IM within the 2.8km catchment defined by the distance by road.

Traffic, connectivity and urban classification

The actual traffic count around the Catholic school was not associated with IM once other factors were adjusted for. The number of car parks at the school, and walkability of the neighbourhood were also not so important, which was consistent with the findings of McMillan, Hume, Carver and Timperio and Brown (McMillan, 2009; Hume et al 2008; Carver & Timperio, 2008; Brown et al., 2008), but in distinction to Giles-Corti (Giles-Corti et al., 2011). Overall, this research supports the position of McMillan, who argues that urban form factors affecting the walkability of a neighbourhood, such as street layout and connectivity, traffic density, and proximity to shops and schools (mixed-uses) are less important than other factors such as social demographics and cultural background.

Urban form may be less important in Catholic schools, but the urban classification of the school location was still associated with CIM. This research has found that children attending Catholic schools in outer urban areas were 15% less likely to be independent than the child in inner suburbs, and those in regional areas were 1.2 times more likely to be independently mobile.

Parent perceptions of the built environment

Why one parent living the same distance from school allows their child to walk or cycle independently, and the neighbour next door does not, is related to parent perceptions of safety and risk, and the competency of the child. Previous research has shown conclusively that parent perceptions are important in determining IM behaviours of their children (Hillman, 1990; Tranter, 1993; McMillan 2007; Gill, 1997). I have found that a key factor in predicting CIM is the competency of the child. That is, a parent assesses that a child has gained the competency to travel safely, and then allows their child to travel independently around the neighbourhood (Villanueva et al., 2014). The parent's perception of traffic volumes was associated with IM, in agreement with Tranter (Tranter, 1993) and Curtis (Curtis et al., 2015).

Parents who perceived high traffic volumes , were 59% less likely to allow their children to be independently mobile compared with parents who did not think so. The result concerning traffic volumes is important, as it confirms the argument that when traffic volume is perceived to be high, then children tend not to be permitted to walk independently, but if the school has a strong focus on safety programs, both in terms of road safety skills and stranger danger awareness, it allows the parent to be more trusting that their child will be safe if they allow them to walk to and from home (Trapp et al., 2012).

Conceptual model of CIM in Catholic schools

In chapter 2 the ecological model was posited to best explain the interaction of the various factors in producing independent mobility in a child. Based on the findings of this study, the final model has been formed of the factors that were identified in the discussion above (Figure 1.1).

In this model, the four layers or niches identified are the individual, social connectedness, school characteristics, and built and social environment. The various factors were put in the four layers. To predict whether a child will be independently mobilie on the trip to school, the various factors in each layer combine to an aggregate score of factors for each child. This model is not inclusive of intervention programs, as it does not assume that a child has been exposed to them.

The relative effectiveness of the programs to increase CIM

The second major objective of the thesis was to evaluate the effectiveness of the three programs – Ride2School (R2S), Safe Routes to School (SRTS) and TravelSmart – in changing the independent mobility of a child.

Very little increase in independent mobility was experienced by schools in the programs. In fact, overall more students declined in CIM than increased. Once other factors were adjusted for, the model built to predict the change in CIM did show that intervention programs had a small positive effect once the cohort was reduced to those who lived within 2.1km of the school. Students in the SRTS program were less likely (32% chance) of decreasing CIM compared to the non-intervention students. However students in SRTS were also less likely of increasing IM (a 73% chance) compared to non-intervention students. Once other factors are adjusted for, schools in Ride to School intervention

program were 1.5 times more likely to experience an increase in CIM than the non-intervention schools. Despite this, the influence of the variable (Intervention Programs) was not significant in the model to predict change in CIM post-intervention.

At one level, this was a surprising result, and disappointing for schools engaged, however they were consistent with the results gained by Garrard and Crawford in the 2010 evaluation of the Ride 2 school program in Victoria (Garrard & Crawford, 2010). Very small increases (2%) were recorded by them in the Ride 2 School program when parents were asked, however the children reported a small decline of similar size. There was no clear winner in terms of effectiveness of a program to change behaviours once all factors are taken into account.

These programs are generally designed as one-off targeted programs, running over a limited time, say 12 months or a school year. Short term programs may have limited effectiveness (Moser & Bamberg, 2008; Sullivan & Percy, 2008; Garrard & Crawford, 2010). In this context, it is possible that all three intervention programs only drew the attention of parents to the risks inherent in allowing their child to walk or ride independently, and some chose to withdraw the licence to walk or cycle from those who already had it. In non-intervention schools, this increased focus on the risks did not occur, and parents did not necessarily change for the worse or better apart from the natural process of children acquiring more freedoms as they grow older.
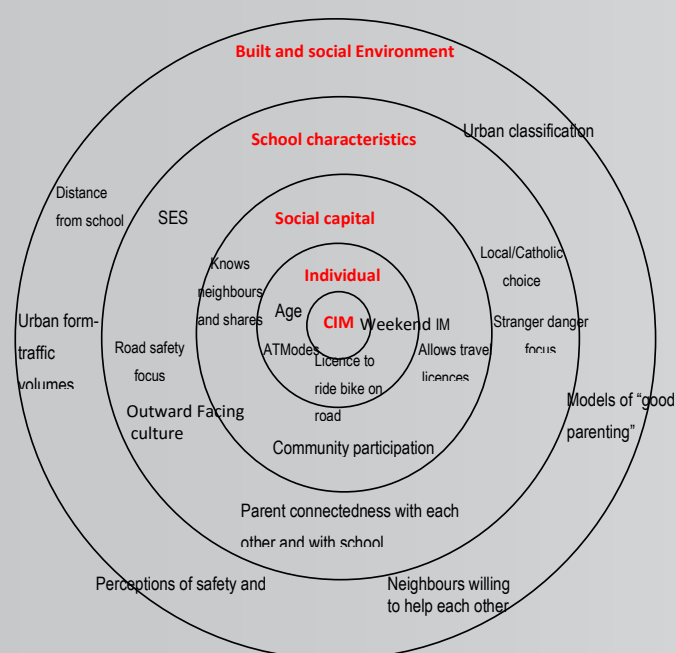

FIGURE 1.1 - *Ecological model of child independent mobility on the trip to and from school*

The role of the school in the effectiveness of the programs

Schools that implemented the program using an embedded model with high levels of commitment experienced the largest increase in IM overall (12%), followed by non-intervention schools (7%), and then those that implemented the program as a stand-alone program (-3%).

Within the stand-alone group, schools that displayed high levels of commitment experienced an increase of 5%, whereas those that showed low levels of commitment experienced a decline of 9%.

Within the embedded group, schools that started the implementation of the program as a stand-alone program but transitioned it over time to be more embedded in school culture experienced an increase of 3%, but those who implemented it from the start were well embedded in the school culture experienced an increase of 17% on average.

This leads to the conclusion that the schools themselves play a significant role in the chances of a successful outcome of an intervention program, regardless of the program. The schools that implemented programs in an embedded fashion will lead to more positive change, and if approached this way from the start, then they are far more likely to experience high levels of change compared to those that treat it as a stand-alone program, even if they transition to a more embedded position later on.

This is consistent with the understanding that schools build connectedness themselves, through their external and internal programs embedded within their culture (Caldwell, 2008). According to Caldwell, this is a form of linking social capital that characterises most effective schools.

The influence of social capital within the school community on the decision to increase IM over the course of the intervention period

While no one program stood out in a statistical sense from the others, students who participated in programs were more likely to have increased their IM over the course of the intervention when the following social capital factors were true:

- The child knows their neighbours well - 4.5 times more likely to increase IM
- The parent's perception was that neighbours were willing to help each other - 14 times more likely

- The parent disagrees with or is neutral to the statement that they share the same values as their neighbours – 7.7 times and 11.1 times more likely respectively

From a school perspective, the key social capital factors associated with an increase in IM at the school were:

- The proportion of parents who stated their choice of school in the first place was for local reasons (it was the local Catholic school or it was close by).
- Principal reports that the school was outward facing i.e. having local organisations involved with the school on the site.

The built environment factors that influenced student change in IM that were school-based were:

- The urban classification variable, where regional schools showed more likelihood of increased IM than students in inner city or middle suburban schools.
- Distance from the school , although this was not a significant factor once the cohort of students was reduced to those who lived within 2.1 kms, the average distance that students lived from home, "as the crow flies"

Many of the influences of the above factors are mediated by the school itself, or are reflections of the school rather than the individual child or parent, such as socio-economic status (SES) and walkability indicators of the environment, or the outward-facing nature of the school.

It is the social capital of the school, expressed as an outfacing "connected" culture that ultimately transforms an intervention program designed to change behaviours of some children (but not for long), into an integral part of the school's deeper educational messaging about student wellbeing, and health. Within this educational scaffold, the benefits of resilience, risk-taking and autonomous learning overcome parent's fears about real and imagined dangers in walking and independent mobility, whether at school or around the neighbourhood(Gill, 2007; Malone and Tranter, 2008). In so doing, they allow the child to grow, and independently learn to manage these risks which are a part of life. This is what education is ultimately about (Gill, 2007).
Previous research has shown that parents have immense barriers to overcome in deciding to allow their children independent mobility at ages below 11 (Tranter, 1993; Malone, 2007; Hillman, 1990;

McDonald, 2008; McMillan, 2007; Nicholson, 2014; Garrard and Crawford, 2010). This research has demonstrated that parents who are making that decision (to allow their child to be independently mobile) believe that they think so differently to their community on this issue that they describe themselves as not sharing the values of the community (Nicholson, 2014) Perhaps this is why intervention programs such as these require the full support of the culture of the school to be more successful.

In speaking about the TravelSmart program in operation in Victoria, Tranter describes the effectiveness of its approach being based around the capacity of the parents to engage as a group with the school to develop strategies that collectively respond to the problem of risks associated with congestion around the school site. In doing so, they build understanding and community as a result (Tranter 2008). If the school itself reinforces these same messages through its normal relationship with parents and students, then they could be even more effective. Strategies taken as individual parents may not succeed because of the strong disincentive to be seen as a bad parent who does not minimise risk to the child above all else (Malone, 2007).

Conceptual model for change in IM and social capital

Does the ecological model posited in chapter 3 explain the interaction of the various factors in changing the status of independent mobility in a child, or is another one required? It would seem that the interaction of factors that help one predict whether a child is independently mobile, may not necessarily assist in predicting that travel behaviours will change when a school begins an intervention program.

Given the above, I have configured a second model that assists in understanding how the decision to change the status of independent mobility might occur as the result of an intervention program. This is set out in Figure 1.2.

The decision to change the independent mobility status of a child as a result of an intervention program rests with the parent. Therefore this alternative conceptual model reflects that of McMillan (2007) rather than the ecological model of independent mobility proposed earlier. In this model, the parent's decision is influenced by an intervention program that the school has implemented, and the approach to the implementation of it, its culture (outward

facing etc), the focus on safety concerns, and the engagement or participation of parents with the school. It is also influenced by the individual factors of each child, their distance from school, the reasons parents made in choosing the school in the first place, the neighbourhood connectivity and trust levels, the perceptions of risk that a parent had, the licences parents give children to travel independently on the weekend, and not least importantly, the mode taken to and from school.

Possible extensions of the research

The analysis suggested that a deeper understanding of principals' beliefs about the importance of CIM and AT is required. Is it possible that they confuse active transport with the degree to which the school encouraged other strategies to get children to and from cars safely, which does not result in independent travel? The general awareness of the issue of independent mobility and its relationship with education and health amongst principals is probably worthy of further research.

Policy implications

The main policy area to be affected is the support for school-based travel behaviour programs, and particularly in the implementation of them, in order to make them effective. It is interesting to note that only one of these school-based programs, Ride 2 School, is currently being supported in Victoria, the other two being discontinued by the State Government or their agencies.

Regarding Catholic school policy, all three programs - Ride 2 School, Travel Smart and Safe Routes to School programs – are capable of being implemented in a way that embeds the program into the culture of the school in a long-term fashion. My research has shown that delivering an intervention program in such a way ensures a much greater chance of success, and has additional benefits in terms of growing the social capital of the school by developing the outward facing connectedness with the broader community, and providing authentic learning experiences for students. On the contrary, if implemented as a stand-alone program over just six or 12 months, it results in a minimal level of behaviour change over the duration of the program, but those effects move on quickly. Garrard comes to the same conclusion in her evaluation of the Ride 2 School program in Victoria, but argues that they need to be supported by area wide policies (Garrard & Crawford, 2010). While that is true, I believe there is a strong basis for them to continue to operate in schools, but within a particular context, embedded in their culture and programs. This would be true for all schools, not just Catholic schools.

If they are to implement an intervention program, all schools should adopt the whole school approach outlined in chapter 6, integrating the program into their student wellbeing and learning programs
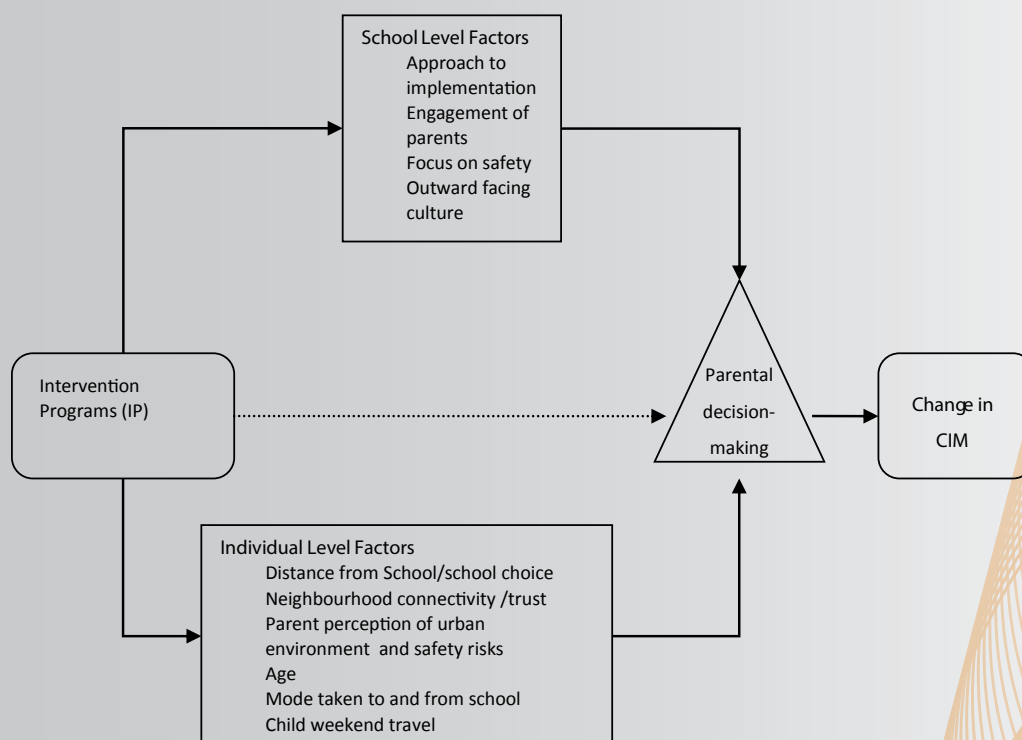

FIGURE 1.2 - *Alternative linear model to explain role of intervention programs in changing CIM*

such as the health and wellbeing and science curricula. The opportunities that the programs provide for schools to design learning opportunities for young students in the areas of student voice, risk management, resilience, health and sustainability are considerable. They can be incorporated into most schools' student wellbeing and learning programs with great effects for individuals and groups.

A lesson for Catholic schools is the recognition of the impact that networks and outward facing policies can have on the fortunes of a school community. During the course of the interviews, it was apparent that many Catholic primary schools did not have a strong, meaningful relationship with their local councillors or senior council officers. For Catholic schools, community was naturally equated to parish, of which it is a sub-set, but too often did not extend to their broader community. If there are not already networks that are part of the school community fabric, the principal of the school can use the social capital he or she posses to create links and pathways for action. At times those communities would benefit greatly from access to the additional resources that the wider community has available.

Some principals may view this as a distraction to their already overloaded schedule, but finding their voice in the network of organisations that serve the broader community is a high priority. If viewed from the point of view of an outwardly facing relational learning organisation, it is not a distraction from the role of the principal, but rather can serve to extend the opportunities for growth and learning within and beyond their school community (Caldwell & Harris, 2008). He or she can invite in external organisations that can create partnerships within the community to change the potential outcomes of the individuals within it. Several schools involved in this research have done this successfully, justifying it within the educational framework of their school. Some communities naturally posses such networks and make decisions accordingly, but others will need their school and their leaders to proactively construct such links. An intervention program creates the context for this to occur. A logical starting point for Catholic schools is their local municipal council.

As noted above, the development of an implementation model for Catholic schools should focus on the challenge of parent engagement. The aim of much of this engagement would be to counter the images they have of good parenting

in the area of independent mobility being equated with risk minimisation or elimination. It could emphasise the benefits of health and fitness, road safety skills, resilience, risk assessment skills, independence, and environmental awareness for their children.

The second major policy area for consideration is that of optimal school catchment size. There are lessons for the maximum size of a Catholic primary school catchment, in order to ensure that children are able to travel to school independently. This study found that beyond 2.1 kms, there was far less likelihood that the student would adopt an active transport mode to and from school. This figure may define the maximum road distance between the students and proposed Catholic primary schools of the future, if they are to expect reasonably high proportions of children to be active and independent. This road distance would result in schools being planned not more than 4 to 4.5 km apart. This distance may limit the long-term enrolment of the school and hence impact on the financial viability of schools in some locations. My knowledge of the planning for new Catholic schools in growth areas leads me to believe that this is reasonably consistent with current planning outcomes. To be sure, further investigations could take place within system administrative authorities to understand the relationship between independent mobility, distance, long-term enrolment and viability.

Thirdly, there are implications for the programs that work with parents and schools about risks and identifying appropriate risk management strategies that do not merely seek to minimise exposure to risks for their children. Children now are restricted to a very small geography or footprint even at age 9 to 11. Adopting risk management strategies which limit the footprint even further will result in further loss of rights for the child. These will have potentially deleterious impacts on the child's health and wellbeing. Therefore schools and communities should be encouraged to explore other approaches which allow our children more time and space to explore their environments independently of adults, while recognizing the dangers in their environment.

This discussion with parents and teachers must begin to challenge the notion that a parent's success can be measured by the extent to which he or she removes all the potential risks from a child's life. The measure of success should shift more towards how well the child has identified and managed those risks, and retained their resilience. Failure

is not measured by the times the child is hurt or bullied, but rather when they fail to deal with this experience and come back to claim his or her place in the neighbourhood.

Conclusion

The association of CIM with social development and learning suggests that schools that encourage independent mobility in their students and families may enable them to be more socially connected, thus empowering them to be healthier, well-adjusted and more capable thinkers and learners (Brown et al., 2008). The converse of this statement is what I have attempted to prove, that schools that encourage and build social capital with their wider communities may have more success in changing travel behaviours of their children to be more independently mobile.

Three factors emerged in the quantitative research that were significantly correlated with the increase in IM at the school level - the proportion of students that travelled independently at the weekend, the initial choice of school because it was local or close, and the presence of external organisations on the school site for educational programs.

The last of these factors is the measure from Caldwell and Harris (2008) which is descriptive of an "outward facing" school, one that is well connected into its community, to the extent that it forms partnerships with other organisations to deliver programs, services and learning opportunities to students. This result links the position of Caldwell and Harris (2008) in relation to school generated social capital with an increase in children's independent mobility. These schools which are outward facing are necessarily schools with strong cultures, including beliefs about student engagement in their learning, encouraging student voice, leading to greater independence and resilience of students (Caldwell & Harrie, 2008, p. 63). This is descriptive of linking social capital which I defined as social capital in this research. These schools experienced greater increase in independent mobility. So in relation to the hypothesis that social capital of the schools mediates the effectiveness of these intervention programs, this research strongly supports this finding in common with previous research (Hume et al., 2008). The further dimension that this research adds is that the role of the school itself in the implementation of the program is critical. By deeply embedding the program in its culture, it

enhances the effect of social capital.

Why would the school do this i.e. embed a travel behaviour change program into their culture? The reason is that it supports the school's efforts to be outward facing, building connectedness and trust in the community, and thereby contributes to the achievement of the schools educational and student wellbeing objectives. This is consistent with the conclusions of Brown in the importance of physical activity in children's growth, particularly their socialisation and independence, (Brown et al., 2008) , Kytta in her study linking emotional and cognitive development with physical activity (Kytta, 2004) and Tranter in his study of Canberra in 1993 about the importance of independent mobility to socialisation and learning:

> "the personal, intellectual and psychological development of children may be related to the level of independent mobility. This development depends on 'active exploration', which is not provided for when children are passengers in cars." (Tranter, 1993)

A principal of a Catholic school in my study concluded afterwards, from a parent's perspective "It is about you, your child, and their environment." They are the gatekeepers, but they should be armed with the proper information to weigh up the risks and benefits adequately. Schools can assist in this process.

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Confusing messages: Is the modern learning environment an example of idealized curricula or disruptive innovation?

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Despite global commissioning of new school designs, there is a body of literature (Lackney, 2002; Moore & Lackney, 1993; Nair, 2002; Nair & Fielding, 2005; Tanner, 2001; Taylor, 2002; Wolff, 2002) that documents the challenges that environmental designers encounter when they endeavour to design for educational purpose. One difficulty has been the problem of negotiating the various ways education is being interpreted and delivered across schools. Jilk (2001), in supporting this notion, argued that environments could actively nudge learners towards freedom and creativity but he is sceptical of freedom, arguing freedom is often assumed, especially in choice of learning programmes offered in schools. In reality, learning often becomes focused and controlled. Changes of the 21st century have led to shifts in international thinking about education and curriculum development and most of all creating the conditions necessary to cultivate powerful 'learners' (Taylor, 2002). The concept of 'freedom' as a way of providing flexible, open learning programmes is a notion continually debated by architectural designers especially in the context of schooling but the tension between 'freedom' and 'focused and controlled,' significantly influences their practice. This paper is the beginning of a study examining the 'modern learning environment' (MLE) as an agent of teaching and learning, and debates the MLE as an example of idealized curricula or disruptive innovation.

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Background

Architects and property managers in New Zealand face major challenges when designing educational environments that reflect 21st learning and a revised New Zealand Curriculum (Ministry of Education, 2007). The New Zealand Curriculum clearly indicates that education is in a period of one of the biggest changes in educational history that will potentially render previously designed physical environments and long held philosophical views of pedagogic practice redundant.

Changes such as this (especially to secondary school education) signal a philosophical divergence to previous models of schooling and will not only significantly influence the design of the learning environment but also signal a need to question the relevance of pedagogy and curriculum. In the past five years several new schools have been designed, built and occupied that reflect a spatial configuration more suited to a very different approach to learning and have become known as 'modern learning environments', (MLE's). Since their implementation the modern learning environment has avoided a rigorous examination of its design, function and purpose and even though designs emulate international thinking, their context in New Zealand's educational system needs to be critically appraised.

In 2002 the New Zealand Ministry of Education, along with a newly elected government, launched a project named 'Secondary Futures' (Ministry of Education & Secondary Futures, 2004) to open a dialogue, with a diverse set of participants, about the purpose and direction of secondary schooling. Secondary futures collected formal written feedback from over 900 participant workshops to establish that the time was right for exploring alternatives to the bureaucratic schooling systems in New Zealand (Roberts & Gardiner, 2005). Within this literature there is a reference to 'schooling for tomorrow', and '21st century schooling', and was the foundation thinking for '21st century learning' and the 'nature of teaching in the 21st century' referred to in current Ministry of Education documentation and policies.

Learning For the future

Teaching for 21st century or 21st century learning are terms that are interpreted in a variety of ways, future focused, learning for the future, futures education, and lifelong learning. Whichever term is used amongst educational professionals, there appears to be similar perspectives about what it means, preparing students for a future that is very different to what it has been in the past. A future that is recognised as a revolution where accelerating innovations and technological advancements have changed the way people live, work and socialise. Burns (1995) argues that people living in the future will need to be adaptable, be problem solvers, be creative, connected, collaborate, share their learning, expect rapid change, and function in an information rich society. Businesses and industry will need to cope with global competition making work unpredictable, uncertain, and ultimately changing the way we learn, work and live our lives (Wagner, 2008).

There is an acceptance that education must change to meet the needs of learners who are born into a world significantly different to any that has been evident in the past. The influence of a highly technological age has impacted people's lives, social patterns and career options. This explosion of technology has changed the way information can be obtained and shared and the way learners communicate. Learners are no longer dependent on the teacher being the font of all knowledge and in fact are more informed in some concepts, than teachers (Beetham & Sharpe, 2013; Bull & Gilbert, 2012; Carmean & Haefner, 2002; Coppen, 2002; Schlechty, 1998; Wagner, 2008)

Bull & Gilbert (2012) argue that, "New approaches are needed if our young people are to develop the "dispositions" (to knowledge, thinking, learning and work) needed to productively engage in the

21st century world, " (p. 1). Robinson (2001) reinforces the need to review our understanding of intelligence, human capacity and of the nature of creativity. Goleman (1996) recommends the development of intrapersonal and interpersonal skills. Scardamalia & Bereiter (2006) debate an interesting shift from treating students as learners and inquirers to treating them as members of a knowledge building community which as they admit lie outside the scope of most constructivist approaches.

Leadbeater and Wong (2010) see a need to implement transformational innovation. Transformational innovation will create new ways to learn, new skills, in new ways, outside formal school and see these programmes:

- pulling families and children to learning by making it attractive, productive, and relevant
- rely on peer-to-peer learning rather than formal teachers
- create spaces for learning where they are needed, rather than just using schools
- start learning from challenges that people face rather than from a formal curriculum

Leadbeater and Wong (2010) argue, "there is an ingrained failure in current education, education systems that were established more than a century ago underperform, mainly because they fail to reach and motivate large portions of the population" (p. 3). Their work debates four essential strategies: improve, reinvent, supplement, and transform schools and learning.

New Zealand education curriculum designers have responded to this philosophical shift with curriculum changes that place the 'learner' and values centred around life-long learning, at the centre of the education process, redefining teacher actions that promote 21st century learning (Ministry of Education, 2007, p. 34). Within the context of this study, I will use the term '21st century learning' as the metaphor for all things that relate to preparing students for their future including the nature of the learning environment as a vehicle for learning for the future and a rapidly changing world.

Philosophical values associated with previous models of teaching and a revised emphasis on learner-centred self directed programmes presents a very different working culture and challenges spatial designers to design spaces suitable for a range of potential models of teaching and learning.

Different kinds of schools are needed to teach new skills in new ways (Lackney, 2002). Schools such as this have been designed, built and inhabited in the last five years and will be the focus of this study.

Environmental challenges

There is a solid body of literature (Lackney, 2002a; Nair, 2002; Taylor, 1991/2002; Washor, 2003; Wolff, 2002) that clearly documents the problem that environmental designers encounter when they endeavour to design for educational purposes. One difficulty has been the problem of negotiating the various ways education is being interpreted and delivered across schools. The conventional wisdom of some school leaders is that educational facilities are about 'containers' in which students are treated as vessels to be filled (Lackney, 2002a). Until recently many educational decision makers and environmental designers believed that the design of these containers had little to add to the educational process (Clark, 2010).

The above authors were also pioneers for school environment change and continue to emphasise the influence school buildings have on student comfort and performance by focusing discourse on analysing the transformational effects of acoustics, natural light, colour, warmth, visual connectivity and ergonomic suitability. Nair (2002) argued that school buildings have been and continue to be places to warehouse children, and that new school's just do it in more comfortable settings. He considers that although research is still sparse when it comes to evaluating the benefits of non-traditional learning spaces on learning outcomes, there is solid evidence that 'progressive methods' of education do work when properly implemented, so it makes sense that school facility design should follow suit and support the new teaching and learning modalities. With international developments in educational thinking associated with 21st century learning, and the successful implementation of new learning environments in other countries, there is now literature that supports and verifies the benefits of designing and building new learning environments (Bergsagel, et al., 2007; Fisher, 2005; Lackney, 2001b; Nair & Fielding, 2005; Semper, 2003; Walker, Brooks & Baepler, 2011; Wolff, 2002; Woolner, 2012). Over the last ten years the New Zealand Ministry of Education has invested in many new secondary schools, all of which have evolved ideas of modern learning environments. Now that these schools have been commissioned and are operational, there is a need to study the synergy of the designed

environment to meet the needs of 21st century learning and evaluate its success through the eyes of the inhabitants.

The focus of the study

The commissioning of modern learning environments (MLEs) in New Zealand that potentially act as a form of disruptive innovation suggests a need to study the impact of spatiality on pedagogy and learning, and about what students should learn in MLE, how we should measure the success of all this and most importantly how education can contribute to future design process. Therefore, research is required to critically examine the design practices of architects who have created the modern learning environment and to understand the teaching (pedagogic practice) and learning that these environments support. Understanding the design practices of the architects in creating the MLE (for what is, potentially, an idealised figure of curricula) and evaluating the practices of teachers and students who inhabit this environment, raises questions regarding the alignment of compatibility between spatiality for educational purpose and its actual functionality for teachers and learners. Indeed, such research may bring into question the very possibility that the traditional purpose of the classroom, and by extension, the school, is set to change irrevocably in the near future.

The focus of this study will examine and analyse the nature of purpose built designed environments, pedagogy, learning programmes and the perspectives of students and teachers who work in the 'modern learning environment,' and report on the progress of the designed modern learning environment to facilitate 21st century teaching and learning in two Auckland secondary schools. Data gathering will incorporate views from architects, school leaders, students, and teachers. The reason for studying secondary schools lies in the struggle these schools have in interpreting a dualist New Zealand curriculum document to make a transition from traditional industrial pedagogic models of learning (perpetuated by the demands of managing tightly controlled student assessment practices) to a 21st century learner-centred model that espouses more flexible, highly interactive teaching and learning approaches. Anecdotal information fuels assumptions that this forms a dichotomy and a dilemma for schools (as modern learning environments) endeavouring to develop future focused learning programmes.

Methodology

This study aims to define and evaluate the impact of MLE on teachers' pedagogic practices and student learning. It draws on qualitative inquiries into the practice of designing modern learning environments and teaching and learning practices within these environments and relies on data gathered to support further discourse on the alignment between designed environment and pedagogy for 21st century learning.

Research methods will be used that offer the potential to penetrate deep to the human experience by tracing the essences of the practice of educational environmental design and the practice of teaching and learning in the created environment. Methods that emphasise narrative, discovery, and meaning rather than prediction control and measurement, (Osborne, 1994) are preferred as they enable the gathering of rich examples of lived experience. The approach chosen for this qualitative research study is based on hermeneutics, which is concerned with the nature of human interpretation and understanding, and lived experience. Hermeneutics allows participants to interpret what is perceived and to make sense of their perceptions (Ramberg & Gjesdal, 2009). Hermeneutic theory posits the hermeneutic circle (Ramberg and Gjesdal, 2009; Weinsheimer, 1985), which means that (a) all interpretation is biased by one's previous experiences, world-view and personal history, (b) new perception and interpretation leads to new understanding and the creation of meaning, which (c) shapes a person's beliefs, world-view and self-concept. The place of interpretation in hermeneutic processes means language is significant (Kinsella, 2006; Ramberg & Gjesdal, 2009). Hermeneutics as a research approach embraces the contextualised nature of interpretation and understanding and concentrates on historical meanings of experience and their developmental and cumulative effects on individual and social levels, (Barclay, 1992; Polkinghorne, 1983). Research findings are always dependent on the context of the research study, as well as the researcher, (Kinsella, 2006; Roberge, 2011). Denzin and Lincoln (2000) view investigator and the investigated as interactively linked in the creation of findings within the process of interpretation and interaction between the investigator and the research participants. As Jardin (1992) states:

Hermeneutic inquiry has as its goal to educe understanding, to bring forth the presuppositions in which we already live. Its task, therefore, is not to methodically achieve a relationship to some matter and to secure understanding in such a method. Rather, its task is to recollect the contours and textures of the life we are already living, a life that is not secured by the methods we can wield to render such a life our object.

meanings and essences of participant experiences inherent in designing a modern learning environment that represents a particular style of education (for 21st century learning), and the way in which the inhabitants are prepared for, and practice in such an environment.

This research is designed as a multiple case study (Figure 1). Case studies specifically enable the contextualisation of the phenomenon of interest (the design and educational intentionality of an MLE), and are most commonly applied where the phenomenon of interest is complex and highly contextualised, with multiple variables unsuitable for control (Yin, 2003). Case studies provide the researcher the opportunity to develop a deeper understanding (Berg, 2007) of the way individuals perceive their professional connection with these environments. Two case studies will provide sufficient evidence to understand the hidden
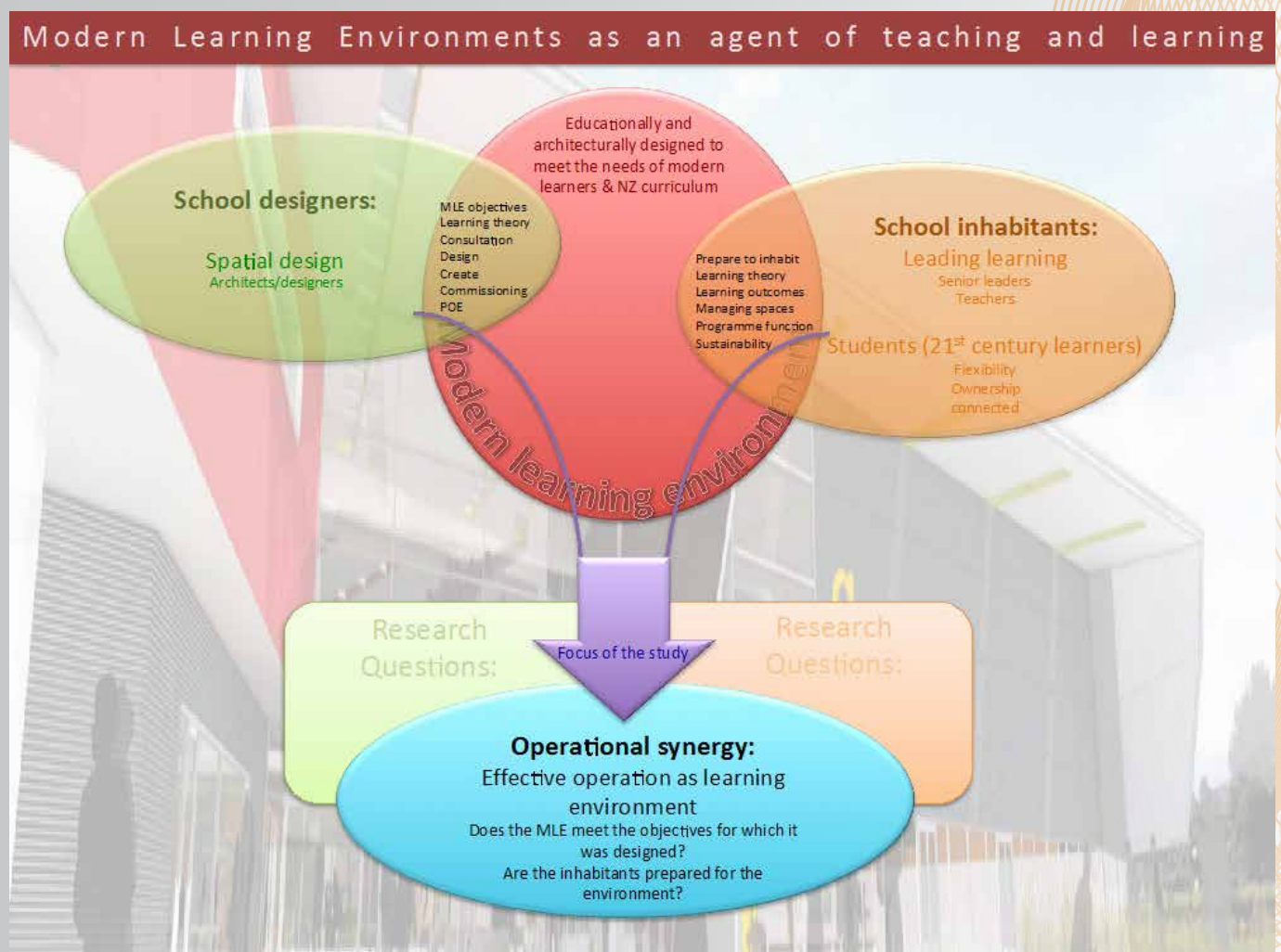

FIGURE 1 - *Modern learning environments as an agent of teaching and learning.*

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Engagement within interest-driven learning environments

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This paper develops a theory of short term, shared engagement accompanied by a spatial notation system in open ended, interest driven learning environments to support, extend and assess interest-driven and connected learning (Ito et al., 2009; Crowley & Barron, 2014) across everyday, informal and formal boundaries. It simultaneously introduces the notion of personal curation, broadly defined as the ability to capture, edit and share information with personal information devices, to describe emerging socio-technical practices that expand the possibilities of interest-driven, connected learning.

The empirical basis and setting of this research is a two year ethnographic study to understand how visitors cultivate interests in and learn about the diverse historical and cultural heritage of American Roots and Country music while visiting a nationally renowned museum located in the mid-South region of the United States ("The Hall"). We conducted 22 multi-perspective video recorded case studies of visitor group mobility and interaction (including 11 family groups) across a complete visit within the museum's gallery spaces. We additionally conducted 1-2 hour post visit interviews with all visitor groups that often included walks back through the museum, and when possible, we followed online content curated by visitors from their museum visit across a variety of social media platforms. Our analysis and findings reflect a growing body of research focusing on how learning can depend on or arise from making places for engaging with entities or phenomena that interest learners relevant to both the design and evaluation of formal and informal learning environments (Ma & Munter 2013; Lave, 1988; Lave, 1984).

Ben Shapiro

As a member of the Space, Learning and Mobility Lab at Vanderbilt's School of Education, Ben conducts research projects, designs experimental teaching and learning activities, and writes about relations between space, mobility, and learning. His most recent projects include collaborations with the Country Music Hall of Fame & Museum to map historical archives onto surrounding cities through emerging digital technologies and various projects with the Nashville Public Library. Ben is co-founder of Design for America Vanderbilt, part of a network of student-led studios creating local and social impact through interdisciplinary design. He also serves as a T.A. for Professor David Owen's Massive Open Online Course (MOOC), Leading Strategic Innovation in Organizations.

Background & purpose

Supporting and extending interest-driven and connected learning across everyday, informal and formal boundaries is of increasing interest to educators and learning scientists (Ito et al., 2010; Crowley & Barron, 2014), but how it gets organized and assembled in particular settings is not fully understood. Likewise, it is recognized that in order to understand, assess and design for such learning educators and learning scientists must develop new and empirically rigorous methods to define and communicate the development of interest across space and time (Lemke, 2015; Crowley & Barron, 2014). This study aims to better understand interest driven and connected learning by theoretically advancing our understanding of the dynamics and qualities of engagement while simultaneously developing tools to capture and communicate these dynamics and qualities of engagement across space and time.

Likewise, this particular study is informed by and contributes to a growing body of scholarship on visitor behavior and learning in museum spaces. We do not survey that literature here, however, it is relevant to point out two trends in this literature. First, museums and archival collections are redefining their mission, from curating and conserving collections to engaging the public in conversations about the meaning of archival material in relation to broader societal themes. Second, studies of visitor behavior are shifting away from understanding gallery exhibits as a fixed curriculum that visitors succeed or fail at understanding, and towards a view of visitor engagement and interaction as an "enacted curriculum" (Crowley & Jacobs, 2002). Learning opportunities can be designed, but learning is in the hands of visitors.

We begin by providing an overview of this study that occurs within a museum context alongside our research questions and methods. We then focus a detailed case analysis around a family of five from Big Sur, CA supported by a representational system we call a Mondrian Transcript™, to illustrate the dynamics and qualities of their engagement and learning within a particular museum gallery space.

We conclude with findings regarding engagement and interest-driven and connected learning applicable to educators, designers, and professionals working in formal or informal learning settings.

Overview of the study, research questions and methods

The empirical basis and setting of this research is a two year ethnographic study to understand how visitors cultivate interests in and learn about the diverse historical and cultural heritage of American Roots and Country music while visiting a nationally renowned museum located in the mid-South region of the United States ("The Hall"). We frame this learning theoretically as being elective (i.e., learning is voluntary, without formal teaching), driven by personal interests (Azevedo, 2013) and the cultural identity of visitors, and connected (Ito et al., 2009) to friends and family members who need not be present during the museum visit.

Initial fieldwork included observations of typical visitor activity in gallery spaces and working with museum staff and exhibit designers to develop and install new exhibits. Subsequently, we began our study with two primary research questions pertaining to visitor engagement and learning within the museum:

1. How do visitor groups engage with exhibits in gallery spaces? Are there typical 'engagement forms' within the talk and mobility of visitor groups?

2. How do visitors make sense of their experiences with exhibits in ways that further their interests and connected learning?

To answer these questions, we collected and analyzed a purposive sample of complete museum visits across 22 visitor group cases including 11 family groups (2-5 visitors per group). These 22 case studies captured continuous, multi-perspective video and audio records of visitor group mobility and interaction (including 11 family groups)

through small cameras worn by visitors with no researchers present. Visits ranged from 38 minutes to 3 hours and 43 minutes. Typically all members of the visitor group (2 to 5 people) wore a camera or audio recorder allowing us to follow the formation of varying 'engagement forms', what happened during interest-driven conversations, and how engagement ended. We additionally conducted 1-2 hour post visit interviews with all visitor groups that often included walks back through the museum (with researchers present), and we subsequently followed online content (e.g. photographs, videos, messages) curated by visitors from their museum visit with personal information devices across a variety of social media platforms.

Figure 1 provides an overview and descriptive information across the 22 visitor group cases. Comparisons can be drawn across the 22 cases with regards to a number of categories including hometown, length of museum visit and expertise in relation to museum content while also providing information on followed social media posts.

Engagement in a 'bluegrass family'

We focus a detailed analysis of 'engagement' created by a family of five from Big Sur, CA during their museum visit within a particular gallery space (Visitor Group 18 in the preceding table). We call this family a 'Bluegrass Family' for reasons that should be clear shortly.

The members of the family include Blake, Jeans, and Lily, three siblings (6, 10 and 23 years old respectively) along with their mother Helen (mid 40s) and Lily's significant other named Adhir (25 years old). Blake, Jeans, and Lily are

Overview of 22 visitor groups & followed social media posts

The table reads from left to right with each row corresponding to one of 22 groups of museum visitors. For example, Group 1 from Pittsburgh, PA completed their visit together in 1:40. Of the 3 people in the group, 2 shared single posts to the followed social media platforms of instagram and facebook. Together, these posts received 16 likes & comments.

Hometown	Visit Length	People	People w/ Post	Type of Post	Likes & Comments
* family group	*(hr: min)*	** musician*	○ 40-60 yrs old ● 20-30 yrs old • 10-20 yrs old	● ● single post/platform x^x # of photographs ■ album/collage { } multiple visitors	
1 Pittsburgh, PA	1:40	● ● ●	● ●	{ ● } { ● }	16
2 Fresno, CA	1:09	● ●	●	● ■ ■	101
3 Staten Island, NY	47	● ● *			
	1:04	● *			
	1:08	● *			
4 South Korea	0:52	●			
	0:56	● ●	●	■[10]	29
5 TX *	3:43	● ● ● ●	•	■[67]	7
6 Nova Scotia & MI	1:37	● ● *	●	● ● ● ● ●	169
7 Cordele, GA	1:34	● ● ●			
8 Holland, MI	1:09	● ● ● ●	●	●[25] ●[30]	5
9 Staten Island, NY	44	● ●	● ●	{ ● } { ● }	58
10 Iowa City, IA *	1:46	● ● ●			
11 St. Mary's, PA *	1:09	● ● ● ●	•	●	4
12 Owings, MD *	1:16	● ● ● ●	● ● ●	{● ● ● ● ● ● ●}{● ●[3]}{● ●[2]}	103
13 London, UK *	1:07	● ● ● ●			
14 Atlanta, GA	1:39	●			
	2:12	●			
15 GA & England	1:05	● ● ● ●			
16 Hazlet, NJ *	1:25	● ● ● ●			
17 Washington, D.C.	58	● ●	● ●	● ●	58
18 Big Sur, CA *	0:49	● * ● * ● * ● * ● *	• ●	● {● ● ● ● ●}● ●	55
19 Sunrise, FL *	1:56	● ● ●			
20 Milwaukee, WI *	1:08	● ● ● ●	○	●[12]	5
21 Port Charlotte, FL *	1:04	● ● ● ●	• ○	{● ●[12]} {●[15]}	98
22 Chicago, IL *	0:38	● *			
	1:33	● ●	○	{●[9]}	8
Range:	38 to 3:43	2 to 5	1 to 3	0 to 13 Online Postings	4 to 169

FIGURE 1 – *Overview of 22 visitor groups and followed social media posts.*

homeschooled children with deep, long-term, and professional interests in Bluegrass music. Lily has played the fiddle since she was seven years old and studied traditional Appalachian string band music particularly from North Carolina and the West Virginia mountains. She currently attends a well-known university in California. Blake and Jeans have played Bluegrass guitar and fiddle for four years. Jeans also sings and is deeply interested in developing a wide variety of guitar techniques including flat-picking. The family often makes trips across the country to perform with others and one another. They have far less interest in modern Country/Pop music describing to us during the post interview, "We really don't even know what Miranda Lambert sounds like."

Our analysis focuses on the Bluegrass Family's experiences within a particular gallery space that includes a semi-circular set of six exhibit displays containing the original instruments of artists Hank Williams, Lester Flatt, Earl Scruggs, Bill Monroe, Maybelle Carter, and Jimmie Rogers. The gallery space also features an exhibit that focuses on Crystal Gayle and hundreds of vinyl records of famous country and blues artists.

This gallery space contains content that has deep meaning to the cultural identity of the Bluegrass Family. Helen, Lily and Adhir describe their (individual and family) engagement within this exhibit space during the post interview as:

Helen:
"the most impactful was looking at instruments and thinking about what they created from that instrument… Maybelle changed the world with that guitar-you hear those sounds in your head."

Lily:
"Seeing Maybelle Carter's guitar and you hear all of the Carter Family recordings…the sound of her guitar is different than anything else. She had this "meaty sound."

Adhir:
"Looking at Hank Williams guitar made him think of his voice, and then how he died and how the guitar represents the few moments of peace he had in his life."

Jeans and Blake (the two boys) describe this space as the most important space during their visit to the museum as well as their larger visit to the particular city in which the museum resides. Adhir

later equates his standing in front of Hank Williams' guitar as a "gravesite" while also saying "this is the closest I will ever get to Hank Williams."

The following visual representation (Figure 2) portrays the Bluegrass Family's experience within this space during their museum visit. In particular, it shows individual movement paths over the eight minutes and 19 seconds they spent within the gallery space in both space and space-time views. This map-like visual representation illustrates a representational system that we have carefully designed and developed called a **Mondrian Transcript™** drawing inspiration from time geography (Hagerstrand, 1970) and methods of interaction analysis (Jordan & Henderson, 1995) in relation to the design of learning spaces and any architectural space.

The transcript illustrates how the Bluegrass Family creates a series of varying engagement forms while walking through an exhibit space featuring many of their "heroes". The exhibit space is shown in plan view. We superimposed paths in the gallery taken by each member of the Bluegrass family over a period of eight minutes and 19 seconds. We subsequently redraw paths for group members over time (horizontal axis), while preserving location in the gallery space with the vertical dimension and varying the line quality of visitor paths.

While we trace the path of every visitor in the gallery, the units of analysis of greatest interest are engagement forms created when individual paths intersect to produce places or to realize existing opportunities for learning. In this transcription system, utterances (not shown here) by individuals are also embedded along their paths, and engagement collects people (paths) and their utterances (fragments of transcript) together to make places for engaging with the exhibits. On the following page (Figure 2) we isolate the paths of Blake and Adhir to show Blake's lively efforts to move Adhir to shift between engagement forms. As evident in the orange path of the older Adhir, he became transfixed by an exhibit showing the guitar used by Hank Williams during the late 1940's. He remains in reverent silence at the exhibit for 5 minutes (horizontal path, minutes .5 to 4.5), while the younger Blake moves back and forth between him and the rest of the family, trying to collect Adhir for looking at and talking about the other exhibits. After checking in on Adhir five times, Blake finally (at 5 minutes along the horizontal scale) manages to lead him on a tour of the remaining instruments (their entwined paths between minutes 5 and 8).

Summary & findings

We often characterize engagement and learning as occurring in places. It is also the case that engagement and learning can depend on or arise from making places for engaging with entities or phenomena that interest learners. Our analysis of the Bluegrass family coupled with a Mondrian Transcript of their engagement in a particular gallery space within the museum illustrates how people can make places for learning as they are on the move, slowing their pace and creating forms of engagement that can produce or realize (existing) learning opportunities that can extend far beyond museum walls and present time. Likewise, while it has been tempting to treat museum exhibits (or other designed environments) as stable information caches for learning, attending to mobility and interest-driven (Azevedo, 2013) engagement with these environments reminds us that what visitors experience is always a personally-edited version (Lave, Murtaugh & de la Rocha, 1984; Ma & Munter, 2014) of what was designed. By analogy to studies of pedagogical practice, designers create an intended curriculum, but visitors produce the enacted curriculum.

This supports two particular findings in our study applicable to a variety of formal and informal settings. First, a Mondrian Transcript provides a representational system and technology to organize individual and group movement in space and space-time to understand how people create objects of interest, learn new things about them, and thereby create or experience interest driven learning. For example, our analysis illustrates how engagement in the Bluegrass family can move rapidly and involve intense movement and/or conversational sharing. Others can slow the pace of movement and conversation—they can create places of reverence.

Second, visitors experience a personally edited version of the gallery space shaped by their social history and personal interests. The Bluegrass Family's experience described in our analysis is unique to their cultural identity and interests as individuals and as a family. Other visitor groups and individuals across our 22 cases illustrate how hobbies such as guitar building

A Mondrian transcript of family engagement within a museum

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The transcript depicts the movement of a family of five across a particular museum gallery space featuring exhibits of artists including Hank Williams, Lester Flatt, Earl Scruggs, Bill Monroe, Maybelle Carter and Jimmie Rogers. Colour designates individuals within the family. Movement is shown as it unfolds over space and over pace-time. Engagement occurs when individual movement paths intersect in space-time to produce places or to realise existing opportunities for learning.
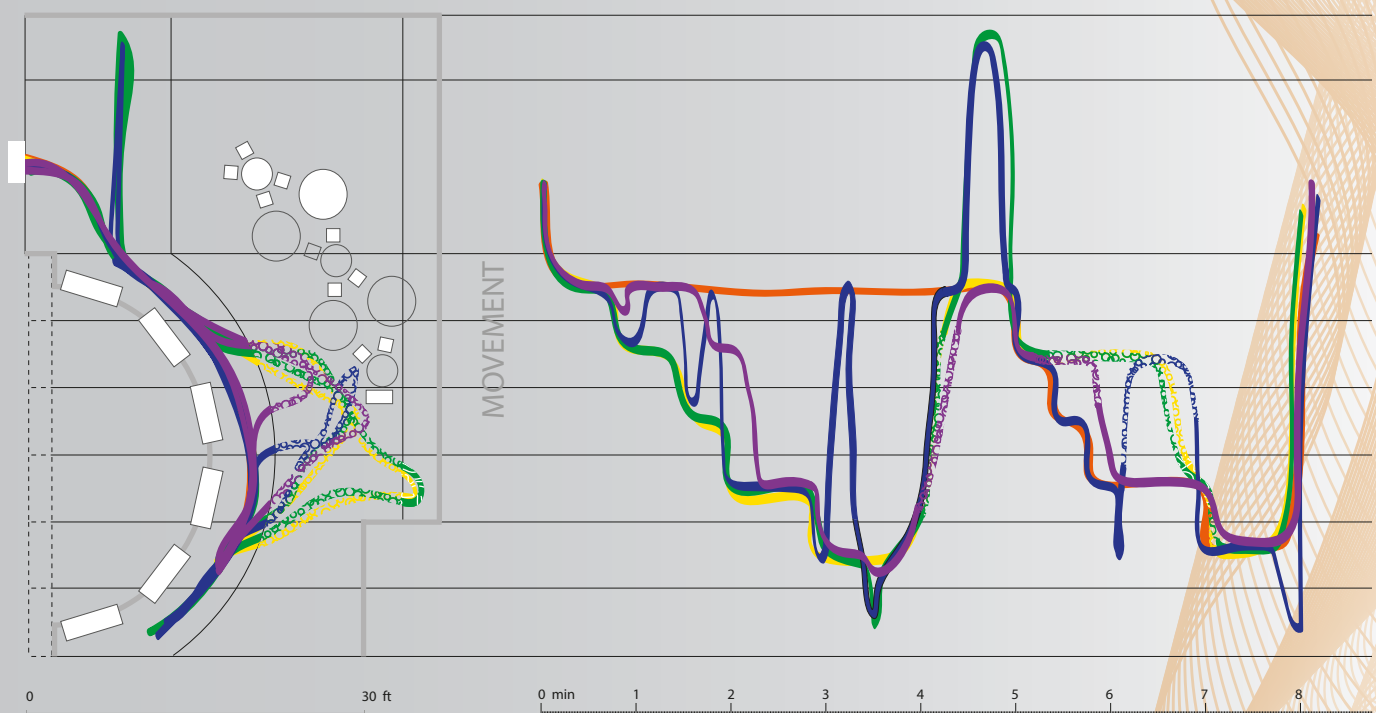
FIGURE 2 – *A Mondrian transcript of family engagement within a museum.*

and weaving, professions such as teaching, dance and entrepreneurship and historical experiences as an African American family growing up in the United States that strongly oppose museum content create vastly different experiences and movement/conversation paths through the same space. Everyone experiences a different museum and understanding this process is of significant value to the design of formal or informal learning environments and perhaps any architectural space.

A Mondrian transcript of family engagement within a museum

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The transcript depicts the movement of a family of five across a particular museum gallery space featuring exhibits of artists including Hank Williams, Lester Flatt, Earl Scruggs, Bill Monroe, Maybelle Carter and Jimmie Rogers. Colour designates individuals within the family. Movement is shown as it unfolds over space and over space-time. Engagement occurs when individual movement paths intersect in space-time to produce places or to realise existing opportunities for learning.
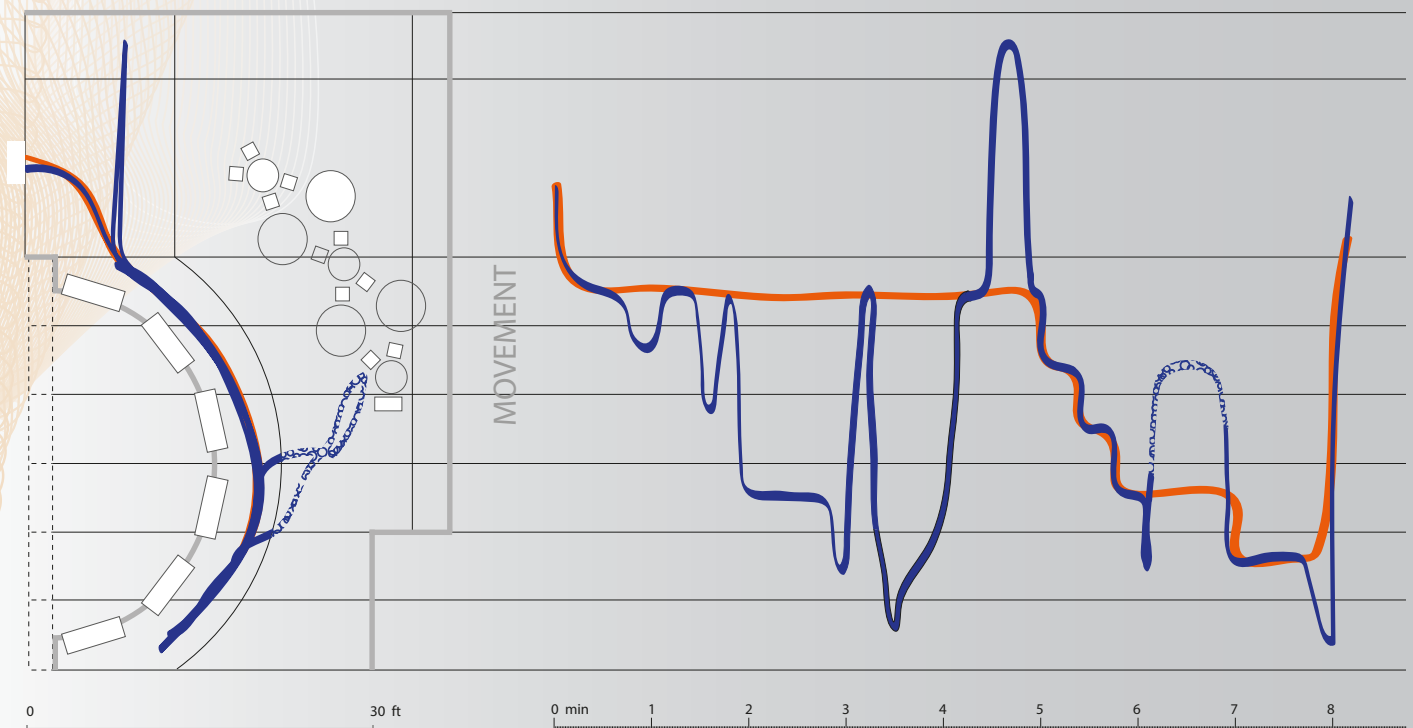
FIGURE 3 – *A Mondrian transcript of family engagement within a museum.*

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Towards a robust framework for evaluating 21st century learning environments.

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With *Terrains*, the three-year *Evaluating 21st Century Learning Environments* (E21LE) Australian Research Council (ARC) Linkage project celebrates its halfway mark. Under the direction of Chief Investigators Dr Wesley Imms, Associate Professor Kenn Fisher, Professor Tom Kvan and Professor Stephen Dinham, its Research Manager Dr Ben Cleveland, and its Project Manager Ms Heather Mitcheltree, E21LE is addressing five challenging questions[1]. When summarised, these seek a theoretical and practical platform to guide effective evaluation of the impact of the rich diversity of active, flexible, student-centred, ICT infused school learning environments that have proliferated internationally in recent years.

A white paper on 'evaluation' drafted by the team in 2014 and to be published in the upcoming *Snapshots* book assisted the E21LE team to very quickly arrive at three directives regarding

1.
- Which learning environments best support 21st century pedagogies?
- What KPIs should be used to measure the performance of learning environments?
- Which secondary school environments best prepare students for post-secondary education?
- How can the following be addressed in any learning environment evaluation: teacher behaviour and practices; student engagement; student learning outcomes; variables that impact learning environments such as school climate, community expectations, socio-economic and socio-cultural contexts;
- What do experts predict to be the nature of future pedagogies, and what implications do these hold for design of learning environments?

this challenging project. First, evaluation of 21st century learning environments must address a multitude of needs and purposes. No one approach is sufficient to do this across the diversity of users of new generation learning environments (NGLEs). Second, what is required is a workable, robust generalisable framework of evaluation. To achieve this, it needs to build new, and collect quality existing evidence-based examples of evaluations, and place these into a user-friendly interface. Finally, the framework needs to trial the applicability in schools of this interface through primary and secondary research methods.

What is quite clear is that E21LE is not looking for a single definition or model of evaluation that will guide its research direction. As the name of this symposium suggests, the project is instead exploring the evaluation 'terrain' that maps how evaluation meets the needs of all; this includes not only educators, but just as importantly the range of associated design professionals-that seek an evidence base to improve their practices. E21LE acknowledges that such an ambiguous goal is problematic, but we believe that with the help of our Partner Organisations, it is achievable.

For these reasons, E21LE is not a single research project, rather, a combination of three 'foundation' and up to nine 'satellite' PhD studies, tied together by an over-arching meta-analysis. E21LE is utilizing the PhD studies to focus explicitly on what 'the field' requires, what already exists, and what knowledge is required to best fill the substantial gaps that remain. This process is being facilitated, in part, by the annual research higher degree (RHD) symposia (*Snapshots* in 2014, and *Terrains*

in 2015) and through co-publication with leading researchers in learning environments research, particularly those situated within the University of Melbourne's *Learning Environments Applied Research Network* (LEaRN, www.learnetwork.edu.au)

The PhDs

Three PhD candidates are contributing to the E21LEs foundation studies. One is *defining* the critical concepts central to E21LE, one is exploring methods for *measuring* these, and one is developing mechanisms *to use* this knowledge in school settings. With the first, Graeme Oliver is utilising an expert elicitation design to identify the qualities of 'innovative design' and 'innovative practice' that must be accommodated in any NGLE evaluation. With the second, Terry Byers is drawing on cross-disciplinary methods from the applied sciences, as well as designing bespoke tools, to develop robust methods for gathering empirical data on student learning outcomes and teacher practices. With the third, Ana Sala-Oviedo is constructing a holistic evaluation strategy that is temporal in nature; it addresses how the practices of designers, educational space planners, and school staff constitute an ongoing, iterative evaluation process and the use of evaluation data to inform decisions about both the design and use of learning spaces.

In addition to these foundation studies, a group of up to nine 'satellite' PhDs are exploring ancillary topics that inform learning environment evaluation. The two RHD symposia have allowed these studies to be situated within the scope of E21LEs evaluation agenda. These topics include: acoustics and designing for inclusion; blended and virtual learning environments; teacher collaboration and the learning environment; leadership and learning environments; the role of the architect in pre-design and post-build phases; non-traditional learning environments such as museums, art galleries and public information venues; the discipline-specific use of learning environments, and the impact of interior design.

The template

The E21LE project has, after 18 months, developed an evaluation template that theoretically accommodates these and other needs and purposes. This framework is being refined through E21LE PhD workshops, co-publications (www.e21le.com) and through peer-contributions by mainstream education and design audiences at

E21LE events such as the Research Higher Degree (RHD) *Snapshots* and *Terrains* symposia in 2014 and 2015, and *Talking Spaces 6* (the annual LEARN event) in 2015. E21LE recognises that "while there has been much attention to the design of learning spaces over recent years, evaluations of learning spaces have been limited in depth, rigour and theoretical grounding, and heavily reliant on informal or anecdotal evidence" (Lee & Tan, 2011). This is, to some degree, a result of the relative youth of evaluation as a discipline. It is generally accepted that an evaluation '…organises, categorises, describes, predicts, explains, and otherwise aids in understanding and controlling…' a phenomenon (Shadish, Cook & Leviton, 1991). Theories of how evaluations actually operate, however, remain works in progress; an evaluation can be prescriptive (setting rules and parameters) or descriptive (hypothesizing suitable approaches). It can be based within a realist paradigm that focuses on the agents that create an outcome (Pawson & Tilley, 1997), or be 'theory of change' oriented (Weiss, 1998), a theoretical approach that looks to results rather than causes. To achieve the scope, rigor and theoretical foundation advocated by Lee and Tan above, E21LE is required to stipulate a theoretical approach that best serves its research goals.

Alkin and Christie (2004) and later Carden and Alkin (2012), have sought to bring some coherence to evaluation theory by providing a 'roots' taxonomy that links all evaluations to three core evaluation functions, *accountability/control*, *epistemologies*, and *social inquiry*. While evaluations may differ in terms of orientations and practices such as 'valuing', 'use or outcomes' and 'methods', Alkin and Christie have successfully argued each can be traced to the three core functions mentioned above. In summary, they believe all evaluations seek to *audit*, to *improve,* and/or to *generate theory.*

Many theorists and evaluation practitioners such as Stufflebeam and Shrinkfield (2007) and Mark, Henry and Julnes (1999) have utilised Alkin and Christie's (2004) theoretical structure to construct a view of evaluation not dissimilar to that now being developed by E21LE and represented in its evaluation matrix (Figure 1). E21LEs analysis of the evaluation literature indicates that evaluation research needs to meet the needs of those who wish to *describe* (assess an observable attribute), those who wish to *classify* (assess underlying structures and categories), those who wish to identify *causality* (assess what outcomes can be attributed

to a program), and those who wish to understand *values* (assess the experiential quality of a program). These needs are neither mutually exclusive nor irrevocably linked, leading us to the concept of the E21LE evaluation template shown in Figure 1. We believe that through this structure E21LE can tailor evaluative approaches to meet the wide diversity of purposes and needs evident in contemporary schools.

The challenge

It is important to note that E21LE is not operating in isolation. The European-based OECD's Centre for Effective Learning Environments (CELE) has been collaborating for some years with CERI (the Centre for Educational Research and Innovation) in an international Innovative Learning Environments project, primarily utilising multiple case studies. In 2015 CELE is planning to use the PISA[2] survey portal to gather 'user data' on student and teacher perceptions of their learning environments[3]. Melbourne's ACER[4] and E21LE (through CI Fisher) are also collaborating in this project. Also of note, the USA-based Educause[5] has established an evaluation pilot tool called the Learning Spaces Rating System[6] in an attempt to accurately compare multiple typographies (Dovey & Fisher, 2014) of learning environments. It is an excellent attempt at codifying evaluation categories

so that we can make better comparisons between the impact of various learning environments.

However, despite these and other programs, there remains a paucity of effective evaluation methods relevant to learning environments (Cleveland & Fisher, 2014), and an aversion to more empirically oriented studies in this field (Byers, Imms & Hartnell-Young, 2014). For E21LE to make an internationally significant contribution to this discourse it must develop a theoretical framework for evaluating 21st century learning environments, then populate this framework with a range of robust 'user-friendly' evaluation strategies, together with a mechanism for determining which is applicable under what scenario. This is the task before E21LE, with its PhD studies addressing the former issue, and the matrix illustrated in Figure 1 addressing the latter.

Terrains has provided another body of knowledge to advance this cause. Its participants are to be congratulated for the quality of their research, and their willingness to contribute to this project.

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

FIGURE 1: *E21LE matrix of evaluation research 'purpose' and 'needs' (after Mark, Henry & Julnes, 1999).*

2   http://www.acer.edu.au/ozpisa/assessment
3   http://www.oecd.org/edu/innovation-education/centre-
        foreffectivelearningenvironmentscele/joinleepandshare-
        goodpracticeineffectivelearningenvironments.htm
4   http://www.acer.edu.au/ozpisa/
5   www.educause.edu
6   http://www.educause.edu/eli/initiatives/learn-
        ing-space-rating-system

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