TRANSITIONS

INHABITING INNOVATIVE LEARNING ENVIRONMENTS

SYMPOSIUM PROCEEDINGS
NORTH AMERICA 2017

WHAT IS NEEDED TO HELP TEACHERS BETTER UTILIZE SPACE AS ONE OF THEIR PEDAGOGIC TOOLS?

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INNOVATIVE LEARNING ENVIRONMENTS AND TEACHER CHANGE

TRANSITIONS 2017: NORTH AMERICA

What is needed to help teachers better utilize space as one of their pedagogic tools?
An international symposium for graduate and early career researchers.

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TRANSITIONS
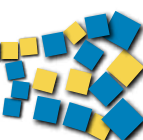## INHABITING INNOVATIVE LEARNING ENVIRONMENTS

NORTH AMERICA 2017

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space as one of their pedagogic tools?

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Contents

Teachers' transition into Innovative Learning Environments: A focus on student learning experiences

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In 2017, the Transitions Symposium explored the overarching theme of *Inhabiting Innovative Learning Environments*. The symposia were held in three cities: Melbourne, Australia; London, UK; and Grand Rapids, Michigan, USA. In collaboration with our project partner, Steelcase Education and with sponsorship from the DLR group, the North American symposium brought together contributors, who addressed the simple question; *'How are teachers making the transition into innovative learning spaces, and how does evidence of success inform future best practices?'*

While the provision of innovative learning environments, or ILEs, in many countries around the world is an exciting and overdue development, they are also presenting a number of new challenges. In particular, anecdotal evidence suggests that many teachers are resisting the need to adapt their proven 'traditional classroom' pedagogies to maximize the learning opportunities provided by such spaces. Transitions provided the opportunity for graduate and early career researchers, often working in isolation, to come together through three international symposia, to be part of this quality discussion, and to be represented in a unique international publication celebrating this research. Through the careful sequencing of papers, and input after each paper by expert interlocutors, Transitions explored how well teachers are making this transition—are these spaces facilitating any improvement in teaching practices? What evidence exists that these spaces are improving student experiences and learning? What is needed to help teachers better utilise space as one of their pedagogic tools? Transitions was a working symposium, with new knowledge being generated from the exchanges of ideas occurring around each presentation.

The papers were grouped into four themes of Inhabiting Design, Teacher Practices, Change and Risk, and Measuring Impact. Participants presented an 8-minute synopsis of their research. There was no concurrent sessions—all participants listened to every presentation. At the end of the presentations in each theme, expert interlocutors discussed key themes that had emerged, drew inferences, and then elicited audience discussion on issues pertinent to each theme. Audience participation was encouraged and robust, drawing perspectives from various sectors including fellow higher degree researchers, industry representatives from design, building and ICT, academics working in this field, and those embedded in implementing new classrooms at a policy level. The day was an intense and highly informative exchange of ideas.

The papers included in this volume, Transitions North America, were selected for presentation through double blind peer-review. The symposium took place on Thursday, 14 September 2017, at the Steelcase Education Center in Grand Rapids, Michigan, USA. Sixty-one participants from industry, policy, schools and academia attended the symposium. Following the event, each paper was reviewed and the comments sent to authors in order to help them prepare a revised version to strengthen the continuity and congruence of the proceedings. The result of this revision process is the backbone of this volume and represents what we consider to be a stimulating and careful set of analyses about how teachers transition into innovative learning spaces.

Three proceedings are planned for papers from each of the symposium. A selection of these papers will be invited to be re-worked and published in the peer-reviewed book, *Teacher Transition into Innovative Learning Environment*, edited by Associate Professor Wesley Imms and Professor Tom Kvan, scheduled to be published by Springer in late 2018.

TRANSITIONS NORTH AMERICA

Following welcome remarks from Sean Corcoran and Andrew Kim from Steelcase Education and Associate Professor Wesley Imms from the University of Melbourne, Pamela Loeffelman from the DLR Group set the scene and context for North America. She talked about the changing nature of student learning and the increasing push from industry for improved education outcomes. She provided some statistics about the changing education landscape in the United States, but noted that regardless of the number of students, the shift towards student-centred learning means that the discussion should centre around how we should engage students—one student at a time.

Dr Pam Moran, superintendent of Albemarle County Public School, in her keynote speech discussed changing learning by changing spaces. She listed seven pathways to transforming learning: Instructional Tolerance; Choice and Comfort; Connectivity; Project-, Problem- and Passion-Based Learning; Interactivity; Maker-Infused Curriculum; and Universal Design for Learning. The key themes that came out of the symposium reflect upon the questions she posed in her keynote speech—questions which she believes provide a roadmap to assist teams of educators and architects navigating through the process of designing ILEs and then implementing the use of those spaces for active learning in the context of an ecological model of schooling. A summary of her keynote address and some post-symposium reflections, available in this proceedings, provide thoughts and directions for the future.

A second keynote speech by Dr Julie Marshall provided a halfway marker and point of reflection for the audience. An Arts teacher at Saluda Trail Middle School, Julie's presentation illustrates how where you are from can shape where you are going in terms of vision, challenges and victories. Her emotionally-charged presentation spoke of her own personal journey in developing an active learning environment for her students.

INHABITING DESIGN

Led by Dr Lennie Scott-Weber, owner and principal of INSYNC: Education Research + Design, this session focussed on inhabiting new ILEs. She noted that the three presenters in the session provided a range of approaches and thinking in their research. Lennie asked the audience to consider the language the researchers are sharing, and their perspectives on their respective research.

Shapiro coined the term "interaction geography" to describe people's interaction over space and time. His research project explores how this concept can be utilised to advance post-occupancy evaluation by providing greater insights into how physical space affects mobility, interactions, pedagogy and learning.

Sanchez employed a multi-case study approach to uncover space typologies for mixed-use learning zones, their associated behaviours and learning impact. Drawing on data from a survey, narrative inquiry and behaviour mapping, she found five typologies and their associated characteristics, which could inform the development of guidelines for architects and educators in the design of learning spaces.

Sun developed the Periodic Table of Learning (PToL), a framework for evaluating learning environments that can be utilised by educators and designers. The PToL was developed in order to create confluency and ensure that both educators and designers are informed and proficient in the purpose and practicality of ILE design.

TEACHER PRACTICES

The panel on teacher practices was chaired by Professor Gary Natriello of Columbia University. As someone from an institution that prepares teachers, he felt the intensifying pressure to get better at preparing teachers to develop instructional activities for complex learners in increasingly sophisticated learning environments. He introduced two thought-provoking papers that aimed to advance our thinking about the preparation of teachers and the environments in which we support teachers in doing what they need to do.

Dillon provided a review and analysis on the research on biomimicry and its implementation into spaces. He argued that the principles of biomimicry can help focus the construction and retrofit of spaces and consequently enable teachers to enact greater learning outcomes for schools.

Mor-avi examined the potential enhancing effect of shifting the school culture paradigm of 'I' to 'WE', to create a tri-function learning hub. She explained that shifting school culture encourages a collaborative atmosphere among students, among teachers and a shared intermediary space in-between where students and teachers can work together.

CHANGE AND RISK

The session on Change and Risk was led by Dr Julie Marshall. Also an Adjunct Professor in the Richard Riley College of Education at Winthrop University. Julie's research and practice has been devoted to linking motivation and interest to student success. Drawing on her own research, Julie argued that active learning environments have a positive impact on student motivation, work completion and academic achievement. She challenged teachers and school practitioners to design and configure learning spaces to better meet the needs of individual learners. Three presentations structured this session. While Kinney and French focused on school- and classroom-level characteristics of successful transitions into ILEs, Kallio investigated the design of physical spaces at the program-level.

Focussing on what could be considered a successful case study school with ILEs, Kinney investigated what the necessary requirements were, from an organisational change perspective, to ensure ILEs are utilised for their intended purposes. Her findings show that a concise and clear change leadership program may explain the success of this school.

French investigated, from a design process, the characteristics that define a successful transition from a traditional classroom to an ILE. Drawing on case studies in Australian and New Zealand schools, she explored the schools' transition into new buildings and how they have achieved the 'buzz'—teachers' and students' engagement with the new environment. Her findings unpack the transition process in order to inform the design, construction and transition of future schools.

Kallio investigated how the design of physical spaces in personalized learning programs (PLPs) facilitate student agency and choice. Affordances that relate to patterns of use by teachers and students in a range of case studies were extracted and four were found to provide meaningful information about use: flexibility (in furniture and movement), student involvement in the design process, spaces designated for purpose and frequent meeting of a local learning space. Each of these affordances aligns with student-led pedagogies and points towards potential mechanisms for developing agency and community.

MEASURING IMPACT

Associate Professor Robert Talbert of Grand Valley State University led the last session on measuring impact. He challenged the audience to think about what it means for something to be 'impactful', what does impact look like, and how do we quantify something in order for it to be measured? The three very interesting papers have slightly different perspectives and approaches regarding impact—and he urged the audience to look for commonalities and differences about impacts and measurement.

The papers in this session focus on the impact of learning spaces on the development of 21st century skills in students. While Moore and Mann emphasised inquiry, problem-solving and collaborative skills, Zhang and Chiasson focused on creativity and computational thinking skills respectively.

Drawing on both quantitative and qualitative data, Moore and Mann investigated the use of an Innovative Learning Space at Ball State University to improve student outcomes and faculty growth, and explored new pedagogical approaches. Utilising inquiry, problem-based learning and collaborative learning, and making use of the facilities offered in the interactive space e.g. movable furniture, they found evidence of collaboration and students' taking ownership of their space.

With creativity becoming increasingly regarded as a significant 21st century learning skill, Zhang presented on the development and validity of a framework for designing and assessing educational spaces that harbor and facilitate creativity. Her paper summarized findings from design research at Harvard's Graduate school of Design and Innovation Lab, as well as observations and design work with thirty K-12 schools across the United States.

Chiasson set out to understand the complexity of the relationship between the learning space and the development of computational thinking skill of students. Another 21st century competency required in most industries, Chiasson argued that school systems seem to struggle to design a process favoring its development. His paper set out to answer the question 'Could the classroom (learning spaces) hinder the computational thinking skill development?'

In summary, the presentations in Transitions North America 2017 had a strong focus on students' schooling experiences, and argued, in direct comparison with the Australian event (see Imms and Mahat, 2017), that teaching and learning is changing, so spaces must follow. This was reiterated in Pam Moran's keynote speech and in particular, presentations in the last session. Change is happening to the way students are learning. If students need specific skills to function in the 21st century knowledge economy, how can learning space accommodate this need?

One factor that hindered good practice in the North American context was the influence of educational policy on practice, and in particular the negative impact of funding models. The topics addressed in the North American symposium are questions that are globally relevant. These efforts by graduate and early career researchers—from across the United States and Canada—have enabled practitioners and scholars to continue to work together to understand what we have delivered so far and how we can collectively progress toward our broader goal of improving student learning.

REFERENCES

Imms, W. & Mahat, M. (Eds.). (2017). Transitions Australasia: *What is needed to help teachers better utilize space as one of their pedagogic tools*. Proceedings of an international symposium for graduate and early career researchers in Melbourne, Australia. Retrieved from: http://www.iletc.com.au/publications/proceedings/

Dr. Pam Moran
Superintendent, Albemarle County Public School - United States

The *Innovative Learning Environment and Teacher Change (ILETC)* project team's research, by design, informs the strategic actions essential to supporting changes in teaching practice and design so that "teachers can use the untapped potential of Innovative Learning Environments (ILEs) to improve learning outcomes for students … (and) identify whether there is a link between quality teaching and effective use of ILEs and develop practical tools to assist teachers to adapt their teaching practices to maximise deeper learning."

To accomplish this, the globally-focused *Transitions* gatherings hosted by the University of Melbourne ILETC Project staff brought together diverse micro-communities in which educators, architects, and researchers collaboratively shared perspectives and research on the connectivity between teaching and learning space design.

When was the last time you attended a conference gathering and walked away feeling relaxed, energized, and ready to take next steps with what you learned?

At Transitions North America, held in Grand Rapids, Michigan, quick rollouts of research in each panel session transformed into dialogue brilliantly facilitated by interlocutors who connected participants and researchers in exploration of key questions essential to emerging voice, agency, and influence among progressives who represent diverse fields of educational study, cultures, and geographies of schooling. I found myself at the end of the day thinking that this is what a conference that builds and sustains efficacy runs like.

Transitions North America modeled an attention to user experience through interfaces that connected space, teaching practice, and agency by design. As research was shared by *Transitions* presenters, themes emerged that illuminate critical concepts prerequisite to both design and implementation processes linking space and teaching. Consideration of these themes by practitioners and designers is essential to developing contemporary educational models in which deeper learning experiences are sufficiently transformative.

What important take aways - or themes- emerged at Transitions North America that support alignment of contemporary learning practices and modernized spaces?

- **Space matters to learners**. As Maria Sanchez found in her case studies of mixed-use university spaces, students perceive physical features of space including choice and comfort as critical to their potential to work in the way they need and want to work, individually or collaboratively.

- **Learning what cannot be taught is Important**. In the work of Matt Moore and Ana Mann, they found that contemporary tools and challenges created a multiplicity, integrating diverse international learners into a virtual community space where they engaged in social justice project work that bridged different geography, cultures, and languages.
- **Space facilitates collaboration and creativity**. In her research, Anat Mor-Avi discovered that flexible, open space shifts young people and teachers into collaborative communities of learning rather than sustaining an isolated teaching model that works against contemporary learning needs. To support this theme, creating a culture of agency so that learners can pursue paths of personalized learning must be grounded in the space design principles that were shared by Julie Kallio- flexibility, visibility, variation, and movement.
- **Space materializes different processes of learning**. ILEs offer opportunities to restructure processes of learning from the compliance-driven teaching model to an empowered-learning model as described by Raechel French. Empowered learners are thinking-doing learners and in the research of Mario Chiasson, computational thinking (so much more than coding) competencies were found to develop within spaces that support collaboration, communication, and problem-solving skill development.
- **Space supports both informal and formal learning**. The work of Ben Shapiro to heat map learning experiences in a museum through interactive geography tools and Robert Dillon's work to design physical spaces inspired by the natural world both emphasized that how learners learn can drive the users' interactions within different spaces and with each other. And, Stephen Sun in his research on the transactional relationship between space and learning offered insights into the processes through which education informs architecture and vice versa.
- **Learning Changes Spaces and Spaces Change Learning**. Whether through the fabulous imagery of Jane Zhang's flaring and focusing research data emergent from observations into how learners use space or Taryn Kinney's digging into the impact of space design upon vision and behaviors of those who utilize the space, researchers at Transitions North America reiterated that teaching and learning change by design and this is accelerated through an S-curve inflection point when space changes by design as well.

These themes led me to reflect upon the questions I posed in my keynote at *Transitions North America*; questions that I believe educators and architects must together consider as they create, design, engineer, and build ILEs. These questions provide a roadmap to assist teams navigating through the process of designing ILEs and then implementing use of those spaces for active learning in the context of an ecological model of schooling.

Schools are ecosystems in which learners and educators interface with a variety of spaces and tools essential to the community's learning experiences. Alignment of curricula, assessment, pedagogies, space, and tools with the intentional development of deeper learning experiences that support collaboration, communication, creative and critical thinking, social emotional learning, and knowledge acquisition must occur for children and educators to be inspired, joyful, curious learners in a school's ecosystem. To increase the likelihood of developing and sustaining an ecological mindset about learning for life, educators must engage with students to create a spatial context grounding content in a system of authentic experiences in and outside of built environments. This means taking down the figurative and literal walls and boundaries of schools.

Framing essential questions through a design thinking lens, educators and architects may find they are led to different paths for imagining and developing the connections between space and teaching that augment deeper, collaborative, creative, empathetic learning experiences. These questions are intended to raise the level of discussion about the intentional uses of space to support the pedagogical changes essential to contemporary learning.

- How might we design learning spaces where children would develop and sustain personal understanding? Empathy? Collaborative competencies? Social-emotional learning?
- What if we designed spaces where contemporary children get to change the stories we tell about our own schooling? What if their narrative became stories of the power of their agency, voice, and influence as learners?

- What if thinking in every way possible— collaborative, creative, logical, analytical, effectual, entrepreneurial— became a key end in mind for curricula, assessment, pedagogy, and space design?
- What would change if our educational purpose became democratization of learning so that children could access time, tools, expertise, and space to grow from their curiosity, interests, passion, and joy?
- What if we stopped designing spaces for decontextualized content acquisition but rather designed for contextualized transdisciplinary learning experience?
- What if our goals, outcomes, expectations of learning were not, at their worst, painful, or, at their least, limiting and inconsequential? What would our Design Imperatives be?
- How might we design spaces in which our young people inspire us to become better educators for them?

Imagine the transformative change in school communities when young people know their voice matters, believe in their own agency, and value their influence. The processes to get to such change begin with a profound vision to make what we dream possible. To create the reality of that vision, educators, designers, and researchers must collaboratively integrate their own contextual understanding of why change is necessary with processes that result in a narrative of successful change.

The ILETC project helps to make possible the transition from the traditions of 20th century school buildings and teaching practices to contemporary learning experiences through documentation of changes in pedagogy and space that empower learners. Making this research transparent and accessible provides educators around the globe with a body of evidence to inform educational change now, and into the future.
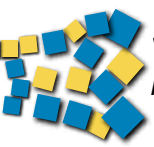
Session one: Inhabiting design
Interlocutor

Dr Lennie Scott-Weber
Insync: Education Research + Design - United States

"Dr. Lennie" is a leading thinker on the evolution of what we know about learning, the learner and the learning place. Passionate about the unanswered solutions that leave students behind in their learning, she has pioneered research strategies addressing how the built environment impacts engagement factors and learner success, and has designed future-focused, evidence-based design applications for 20+ years. Currently, she is the Owner & Principal of INSYNC: Education Research + Design.

Formerly: the founding Director of Education Environments Globally for Steelcase Education; tenured, full-professor and Chair at two design schools [one in Canada & one in USA]; Director of the iLAB Research Center, Radford University; professional interior designer, author, published researcher, national and international speaker. Loves being with family as well as sailing, traveling and staying curious.

Exploring the Use of Interaction Geography to Advance Post-Occupancy Evaluation

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ABSTRACT

In this paper, I explore how an approach to describing, representing and interpreting people's interaction over space and time that I call "interaction geography" advances post-occupancy evaluation (POE) in educational settings. I begin by briefly introducing my use of interaction geography in a study of how visitor groups engage and learn while visiting a nationally renowned museum located in the United States. In particular, I briefly introduce methods of interaction geography such as Mondrian Transcription and the Interaction Geography Slicer (IGS) as well as concepts of interaction geography such as engagement contours. Subsequently, I explore how future POE in educational settings could draw from interaction geography to (a) describe how physical spaces condition not only people's mobility but also their conversation patterns, (b) evaluate the alignment of physical spaces and pedagogy and (c) interpret how people produce and realize their own interest-driven learning.

Ben Rydal Shapiro is completing his PhD in Learning Sciences & Design as a member of the Space, Learning & Mobility Lab at Vanderbilt University's Peabody College. His research and design integrates approaches from the learning sciences, information visualization and architecture to study how people engage and learn in relation to the physical environment and to design new types of learning/information environments and experiences. He is originally from California and received his BA in Architectural Studies from Middlebury College and MEd from Vanderbilt where he helped build collaborations with the School of Architecture at the University of Melbourne in Australia and co-founded Vanderbilt's Design for America Studio.

INTRODUCTION

This paper reflects a larger effort to integrate a field of education research and design called the "learning sciences" with professional design disciplines to advance studies of and designs for more innovative and equitable learning spaces. It does so by exploring how "interaction geography" (Shapiro, Hall & Owens, 2017; Shapiro & Hall, 2017), an approach to describing, representing and interpreting people's interaction I am developing with others in the learning sciences, advances "post-occupancy evaluation" (POE) in educational settings as used and understood by professional design disciplines. I begin by briefly reviewing relevant work in POE and the learning sciences to reveal particular strengths, weaknesses and potential for collaboration across both with respect to studying and designing for learning. Subsequently, I briefly introduce my use of interaction geography in a study of how visitor groups engage and learn while visiting a nationally renowned museum located in the United States. I then use this discussion to explore how future POE in educational settings might draw from interaction geography to (a) describe how physical spaces condition not only people's mobility but also their conversation patterns, (b) evaluate the alignment of physical spaces and pedagogy and (c) interpret how people produce and realize their own interest-driven learning.

RELEVANT WORK

POST-OCCUPANCY EVALUATION (POE)

POE is an established body of research used by professional design disciplines to evaluate the performance of buildings and spaces after they are built with respect to how they influence and "fit" human use and behavior (Zimring & Reizenstein, 1980; Zimmerman & Martin, 2001; Peponis, 2006). In educational settings, current POE focuses on how the physical design of buildings and learning spaces supports or impedes learning (see Cleveland & Fisher, 2013 for full review). Typically, POE in educational settings adopts a positivist stance on how physical structures of spaces shape the learning performance of occupants as perceived by researchers and measured by, for example, standardized tests or "behavior performance scores" (Wineman, Peponis, & Dalton, 2006). In other words, POE rarely focuses on or empirically studies how people use physical structures during interaction to, for instance, distribute pedagogy and power across spaces (Cleveland, 2009; Monahan, 2005) in a way that is essential to what are known as social practice and socio-cultural theories of learning (Lave & Wenger, 1991; Cole, 1996; Vygotsky, 1978). One of the primary strengths of POE relevant to this paper is that it collects evidence that can tangibly inform future design decisions or "design level theories" (Hillier, 2008). Acknowledged research gaps in POE within educational settings include: 1) a lack of "languages" to "describe and explain how a building and environment interacts with students" (Tanner, 2009 pp. 382), 2) a need to better evaluate the alignment between space and pedagogy (Cleveland & Fisher, 2013) and 3) a need for approaches that study and seek to understand how changes in learners' conversation and interaction are evidence of learning or teaching.

THE LEARNING SCIENCES

Though POE makes strong connections to disciplines such as environmental psychology, it rarely makes explicit connections with the growing and interdisciplinary field called the learning sciences. The learning sciences is generally concerned with the "empirical investigation of learning as it exists in real-world settings and how learning may be facilitated both with and without technology" (International Society of the Learning Sciences). Particular strengths of the learning sciences relevant to this paper include developing and using diverse approaches to studying and designing for learning that encompass cognitive, socio-cultural and social practice approaches. Likewise, these approaches explicitly develop methods to study the sequential organization of people's conversation and interaction across different timescales (e.g. minutes, days, months) as evidence of teaching and learning (Erickson, 2004; Jordan & Henderson, 1995). Acknowledged gaps in the learning sciences relevant to this paper are a lack of theories and methods to study the relation between physical movement and learning beyond the scale of gesture as well as how the physical structure of natural or designed spaces influences learning (Taylor & Hall, 2013; Marin, 2013).

INTERACTION GEOGRAPHY IN A MUSEUM

The following figures briefly introduce my use of interaction geography in a study of how visitors engage and learn while visiting a nationally renowned museum located in the mid-South region of the United States (see Shapiro, Hall & Owens, 2017 for a full description of this work). Figure 1 below adapts methods of "time geography" (Hagerstrand, 1970) to map the physical movement of six-year old Blake (blue path) and his sister's fiancé Adhir (orange path) as they visit a museum gallery together.
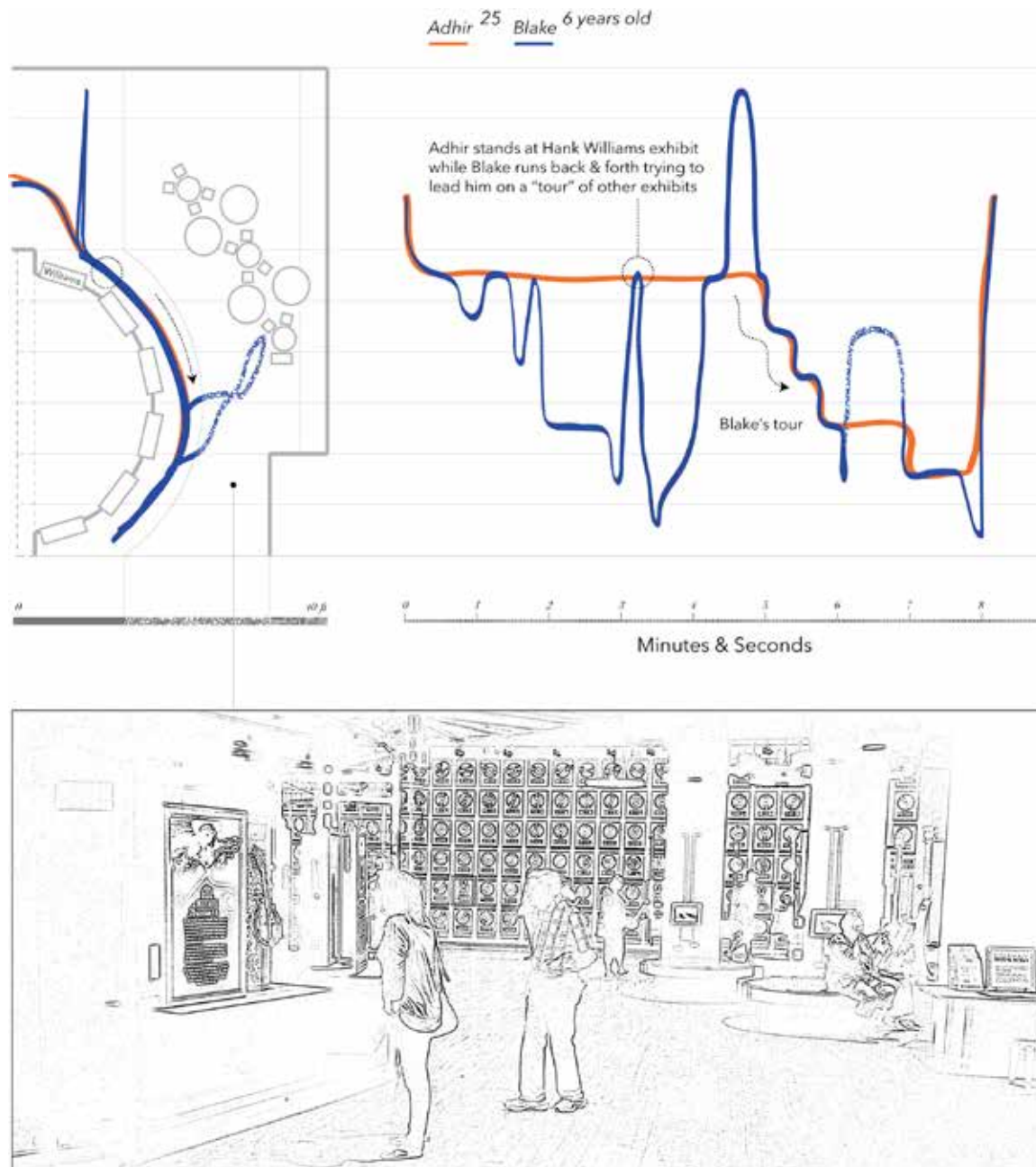
Figure 1: The physical movement of 6-year old Blake and his sister's fiancé Adhir is shown during their visit to a museum gallery space. The left view shows their movement over a floor plan of the space. The right view extends their movement on the floor plan over time preserving vertical location with the Y-axis and distinguishing between three horizontal areas on the floor plan with line pattern. Source: Copyright © by Ben Rydal Shapiro. Reprinted by Permission.

The left or "floor plan view" shows where Blake and Adhir go within the gallery space, while the right or "space-time view" shows how they interact with exhibits and one another over time. For example, using the space-time view, one can see that during the first five minutes Blake is moving quickly (apparently running) back and forth across the gallery space (e.g. across the semi-circle of exhibits on the floor plan) in what appears to be multiple, frantic attempts to draw Adhir away from an exhibit

dedicated to Hank Williams where Adhir remains standing in silent "reverence" of one of his heroes (straight orange path in space-time from roughly 0-5 minutes). After four failed attempts, Blake finally appears to succeed in leading Adhir on a "tour" of other exhibits in the gallery, indicated by their intertwined paths from approximately minutes 5-6.

Figure 2 extends Figure 1 to illustrate more fully a method of interaction geography that I call *Mondrian Transcription*. Figure 2 situates Blake and Adhir's movement and conversation with their entire family's movement (top half) and conversation (bottom half) during their visit together to this gallery space. To map conversation, conversation is transcribed and organized in a manner that draws from and extends conventions of conversation and interaction analysis used in the learning sciences (Erickson, 2004; Jordan & Henderson, 1995). First, each colored line represents a conversation "turn" with color indicating which family member makes (e.g. speaks) that conversation turn. Second, visual boxes group topically related (e.g. usually about artifacts/musicians in this setting) sequences of conversation turns and movement or
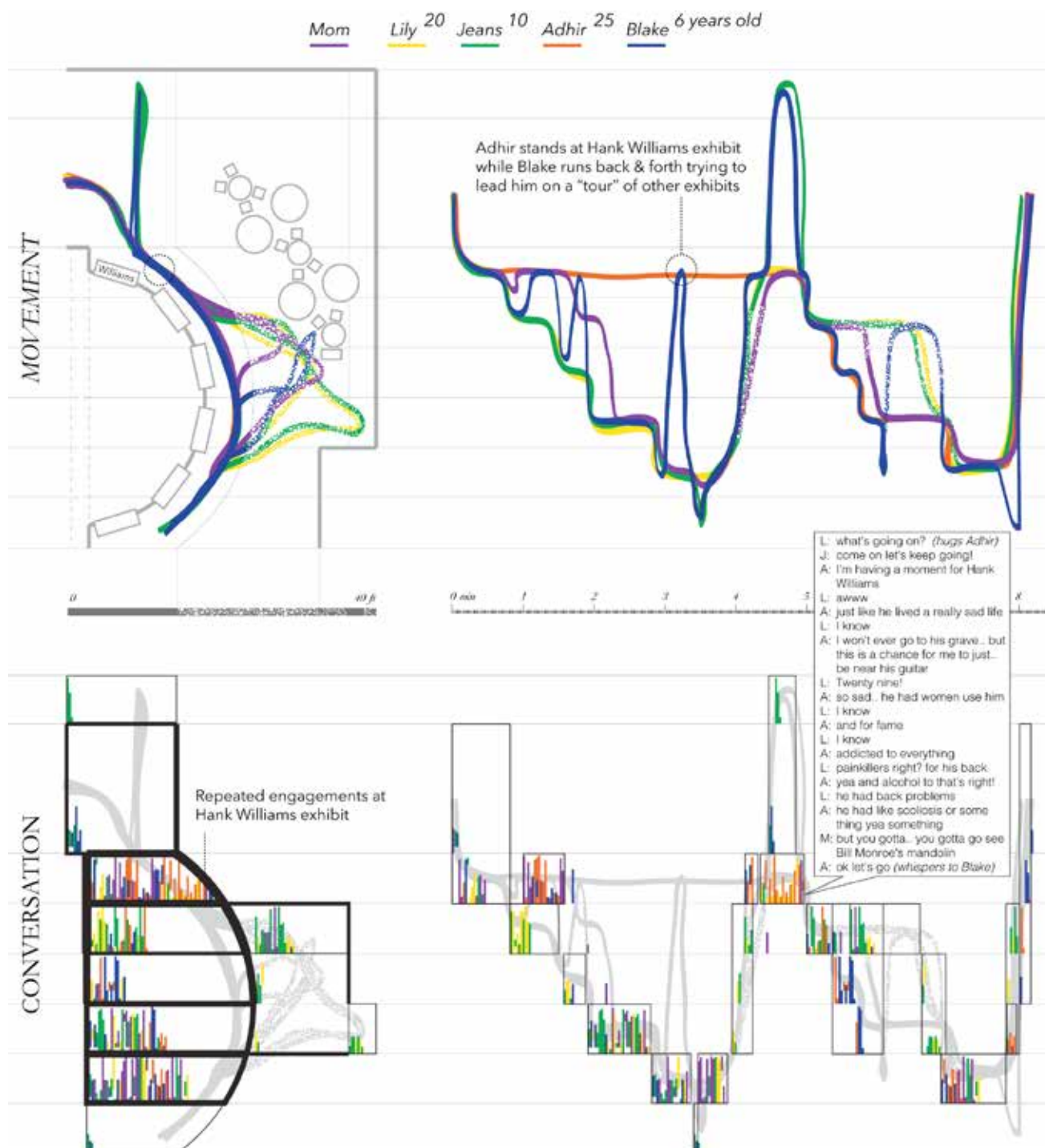
Figure 2: Mondrian Transcript of the Bluegrass Family's interaction geography.
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"ambulatory sequences" (Marin, 2013) over the floor plan and space-time views. In the floor plan view, ambulatory sequences accumulate within regions of space to create what I call "engagement footprints" (e.g. similar to a "heat map" or time-density surfaces). For example, the region of space around the Hank Williams exhibit has the largest number of conversation turns (e.g. indicated by many colored lines of talk) and is enclosed by a dense visual box that indicates many (5 in all) separate (in time) ambulatory sequences occurring at the Hank Williams exhibit (e.g. box thickness in floor plan view increases with each repeated ambulatory sequence).

The bottom half of Figure 2 highlights one visual box in space-time, where the readable text expands the box of colored lines of one particularly important ambulatory sequence where Blake, with help from his mother who finally says to Adhir "you gotta go see Bill Monroe's mandolin," finally succeeds in drawing Adhir away from the Hank Williams exhibit to begin his tour. I call such important sequences *engagement contours*. Engagement contours describe moments of peak engagement that possess a "history of engagement." For the highlighted engagement contour in Figure 5, this history of engagement most notably encompasses Blake's repeated "recruitment" efforts to lead a "reverent" Adhir on a tour of other exhibits.

Figure 5 begins to convey how interaction geography entails fundamentally new ways of describing, representing and interpreting people's interaction in relation to mobility and the built environment or people's "interaction geographies." Moreover, Figure 5 is adapted from a dynamic, visualization environment that I call the *Interaction Geography Slicer* (IGS), which provides ways to interactively explore and study Mondrian Transcripts. For example, one can use the IGS to highlight movement, read conversation (e.g. as shown in Figure 2) and play video/audio (if available) synced to movement and conversation as visualized in Mondrian Transcripts.

Altogether, my previous analysis and discussion aim to illustrate how interaction geography provides ways to ask new types of questions that draw from and extend existing research which seeks to explain, predict and design for people's engagement and learning in settings like museums or schools. For the Bluegrass Family in this museum setting, these questions include: Who is the "1st turn" or lead speaker in each ambulatory sequence or engagement contour? Where, when and how often does each member of the group take a conversation turn? Which members of the group speak at particular exhibits and in what order, possibly revealing active forms of interest-driven learning? How are conversations conducted in view of particular artifacts or displays, and how are these conversations in place linked together, through movement, with conversations linked to exhibit content (or other topics) in other parts of the gallery space? Where and when are there moments of silence? For instance, why during one of Blake's attempts to draw Adhir away the exhibit, does he not speak? Moreover, one can also ask how visitor groups' interaction geographies vary across different families in this gallery space or other spaces and what these variations indicate about how people either engage with gallery spaces as "built pedagogies" (Monahan, 2002) or pursue their own interest-driven learning?

INTERACTION GEOGRAPHY & POST-OCCUPANCY EVALUATION (POE)

Though illustrated with data from a museum, interaction geography may be quite general purpose and applicable to many other settings or technology-mediated learning environments (e.g. other informal learning settings, classrooms, schools, or even larger scale urban environments). In particular, I suggest that interaction geography advances POE in educational settings in three primary ways.

DESCRIBING INTERACTION

Interaction geography describes, represents and interprets the spatial and sequential organization of people's interaction in a manner and at a scale that I suggest provides POE with a means to more deeply and usefully consider both people's movement and their conversation and to do so simultaneously. For example, as shown in my discussion regarding Blake and Adhir, physical movement shown over time at the scale of a museum gallery space can reveal far more about people's interaction than only physical movement shown across a floor plan as is typically the focus in POE. More importantly, Mondrian Transcription provides ways to see and interpret people's conversation over space and time that reveals how people occupy and use spaces to produce spatial areas and temporal sequences of interaction and conversation that may support or hinder

learning opportunities. While the Interaction Geography Slicer provides ways to selectively highlight and read interaction and conversation shown in Mondrian Transcription to more deeply unpack interactions and conversations that comprise learning opportunities. In a museum, these learning opportunities could consist of repeated parent-child conversations at a particular museum exhibit or the processes by which parents or children recruit and teach other family members about exhibit content. However, in educational settings such as classrooms, learning opportunities could consist of teacher-student conversations about topics that accumulate in particular regions of a classroom during particular times of a class period or curriculum unit (e.g. over days, weeks or months).

EVALUATING THE ALIGNMENT OF SPACE & PEDAGOGY

Developing new ways to see the alignment of space and pedagogy is a significant gap in current POE in educational settings (Cleveland & Fisher, 2013). Interaction geography, when used in collaboration with teachers and/or professional practitioners, provides a potentially rigorous approach to seeing the alignment of space and pedagogy in ways that can inform spatial and pedagogical design simultaneously. In particular, I suggest that interaction geography could reveal 1) how teachers use or don't use particular areas of spaces sequentially and repeatedly through their movement and conversation to support learners, 2) when and where learners have access to particular types of instruction or pedagogical interactions and 3) how spaces are experienced through movement and conversation as flexible or rigid spaces or, in other words, as empowering or disempowering "built pedagogies" (Monahan, 2002). Such uses of interaction geography advance existing ways of seeing the alignment of space and pedagogy such as surveys/questionnaires and environmental evaluations.

CONSIDERING INTEREST-DRIVEN LEARNING

As I mentioned previously, POE typically operates from a positivist stance. In a museum setting, such a stance dictates both a model of a museum visitor as a relatively passive consumer of intended exhibit design and evaluation methods that focus on how physical structures of gallery spaces support visitors' acquisition of the intended design and narrative of exhibits produced by museum curators and designers. Such a stance provides valuable information to inform future design. However, such a stance often ignores how people pursue their own interest-driven learning that can be quite different from intended design. Blake's efforts to lead Adhir on a tour provide one vivid example that shows how children's seemingly erratic movement patterns, which might seem to detract from his and his family's ability to acquire exhibit content and narrative, actually reflect Blake's very intentional efforts to pursue his own interest-driven learning. In this case, Blake's interest-driven learning revolves around teaching Adhir about exhibits in the gallery space through what I characterize as a "pedagogical tour". Equally important, interaction geography provides a means to describe and consider Blake's interest-driven learning in this gallery space (e.g. most notably through his dramatic blue path and the distribution of his conversation turns). Put differently, interaction geography provides POE with a means to consider how people "personally edit" (Lave et al., 1984) and "curate" (Shapiro, Hall & Owens, 2017) spaces to pursue their own interest-driven learning. This in turn expands POE to consider how spaces support interest-driven learning or an "enacted curriculum" that may be very different in comparison to how they support an "intended curriculum."

CONCLUSION, LIMITATIONS & NEXT STEPS

In summary, this paper has explored how interaction geography advances post-occupancy evaluation (POE) in educational settings. There are many limitations in this early work. These limitations inform current and future work to, for example, expand studies of interaction geography in other institutional contexts, study how different people and disciplines "read" and make sense of complex, space-time visualizations, address new types of ethical considerations and scale up Mondrian Transcription and the Interaction Geography Slicer as both qualitative transcription methods/software and quantitative visual analytics methods/software for use by others working in a variety of contexts (see Shapiro & Pearman, 2017 and Shapiro, 2017 for uses of the IGS to visualize and discuss New York City's controversial Stop & Frisk Program

and advance social studies education). I suggest such work encourages and necessitates increased collaborations and future research between the learning sciences and professional design disciplines to advance not only interaction geography, but also the study and design of more innovative and equitable learning spaces in ways that are made possible by projects such as the Innovative Learning Environments and Teacher Change Project.

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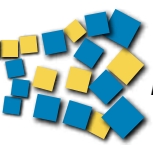
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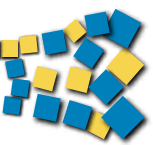
Biomimicry in classroom design

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ABSTRACT

This project looks to weave the wisdom of biomimicry into the brain-based and educator-proven practices surrounding the building of classroom based learning communities for all. Elite institutions have been able to surround students with amazing, inspiring spaces while almost all of the students that attend formal schooling are left without these amazing benefits. This project looks to push back on this widening gap around learning habitats as a way to bring happiness and joy to classrooms as well as bend the arc of poverty that now more than ever holds a predetermined trajectory. To do this, the project leans heavily on the work of biologist and biomimicry popularizer Janine Benyus. In her 2002 book, *Biomimicry: Innovation Inspired by Nature*, Benyus tells us that, "The more our world functions like the natural world, the more likely we are to endure on this home that is ours, but not ours alone."

Dr. Robert Dillon has served as an educational leader in a number of public schools throughout the Saint Louis area over the last twenty years as a teacher, principal, and director of innovation. Dr. Dillon has a passion to change the educational landscape by building excellent engaging schools for all students. Dr. Dillon serves on the Leadership Team for Connected Learning, a Saint Louis based organization designed to reshape professional development to meet today's needs. Dr. Dillon has had the opportunity to speak throughout the country at local, state, and national conferences as well as share his thoughts and ideas in a variety of publications. He is the author of four books on best practices in learning, Leading Connected Classrooms Engage, Empower, Energize: Leading Tomorrow's Schools Today, Redesigning Learning Space, and his most recent book on learning space design called The Space: A Guide for Educators.

BACKGROUND

The intersection of fields of study continue to be where innovation is found. It is in these cross disciplinary conversations that proven concepts become new again with fresh energy to disrupt a new aspect of life. When battery technology runs into transportation, statistics runs into sport, and big data runs into politics, these are the moments when fresh solutions can emerge.

The conversation about the optimal space in which to learn has been around since man took on reasoning as its most human of practices. Since that time, we have also been learning from nature and how it responds to stress and creates solutions in intelligent ways. These two fields have played in the same intellectual space through the academic work in fields like architectural and structural design, but not to the heart of individual classroom design, resulting in very few children learning in optimal spaces that have been designed in both the macro and micro to bring joy, engagement, and deeper learning to the learning habitat.

This project was birthed unknowingly in the desire to bring the philosophy and ideas found in the Cloud Institute for Sustainable Education to life. By growing and implementing this philosophy, the concepts of biomimicry crept into the conversations and lead to the question, "can nature teach us about design?" This simple question with an almost immediate answer of yes leads to more questions than answers, and it leads to a desire for fresh awareness and common language to the learning space design journey at the School District of University City (MO).

The paper outlines an ongoing journey to redesign spaces with intention through a biomimicry lens. It looks to consider how naturally occurrences like fires, streams, forest canopy, and others when observed with learning in mind could expel solutions. A trio of thinkers, inventors, and innovators provide a posthumous board of directors for this project. They are Albert Einstein, who told us to, "Look deep into Nature, and then you will understand everything better." His inquisitive process led to amazing discovery, and it was through observing the details of nature that many of his greatest ideas, inventions, and thought lines emerged.

The second is artist, Andy Goldsworthy, who has found amazing ways to design and be with nature in his sculpting. Goldsworthy creates art that is folded into nature, exists in its beauty, and then returns to nature as a part of its natural cycle. It is in this phenomenon that he is unique in his work. He compels our journey to be with nature in design, create something of beauty in which teaching and learning can flourish, and remember that all design should serve a triple bottom line that supports people, paychecks, and planet.

Georgia O'Keefe rounds out the inspiration for the project. O'Keefe made her way to Santa Fe, New Mexico after being absorbed by the energy of New York City. In her journey to the Southwest, she found a new way allowing the energy of her surroundings to fill her with inspiration. O'Keefe found solace and quiet in the space, and she attempted to share her surrounds and spaces with all that would come. It was O'Keefe that sparked another conversation about listening with all of our senses to the surroundings as there are no neutral surroundings, every space interacts with us by nudging us forward to blowing us backward.

The project is research as conversation, research by doing, research by studying, and research by documenting. It isn't looking for answers as much as it is looking to tear a hole in the space/time continuum that has held our formal education space in generations past. It is beyond time for an inspired, thoughtful look at how biomimicry, in its wisdom and unwavering confidence, holds fresh promise to disrupt the learning habitats that shape the learning habits that are constructed through the education process.

LITERATURE REVIEW

In 1960, the term 'bionics' was coined by psychiatrist and engineer Jack Steele to mean the science of systems which have some function copied from nature (Iouguina, 2012). However, the words later misuse in connection with electronically-operated artificial body parts and the 1974 television series The Six Million Dollar Man led to it being dropped by the scientific community. Otto Schmitt, an American academic and inventor, coined the term "biomimetics" to describe the transfer of ideas from biology to technology and it first appeared in the Webster's Dictionary in 1974 (Priesnitz, 2014).

The term "biomimicry" appeared as early as 1982 but was popularized by scientist and author Janine Benyus in her 1997 book Biomimicry: Innovation Inspired by Nature. Benyus suggests looking to Nature as a "Model, Measure, and Mentor" and emphasizes sustainability as an objective of biomimicry (Priesnitz, 2014).

The characteristics of biomimicry-inspired optimum systems design include: form fits function, resilience, decentralization, effectiveness and good performance, abundance (using what is at hand), bottom-up design, cooperation and collaboration, and the whole is greater than the sum of its parts (Benyus, 1997).

Biomimicry relies on the idea that the planet functions as a system when decisions mimic those in the natural world and resist solutions that are human-centric alone (Benyus, 1997). Moving the concepts of biomimicry closer to daily student learning has the opportunity to impact the stickiness of the learning in a number of areas including: empathy, social and environmental justice, and growing a sense of place in students. The nine principles of biomimicry include: nature runs on sunlight, nature uses only the energy it needs, nature fits form to function, nature recycles everything, nature rewards cooperation, nature banks on diversity, nature demands local expertise, nature curbs excesses from within, and nature taps the power of limits (Benyus, 1997). Though the concepts as originally described have some limits as we conceive new ways to pursue classroom design, there are clear points of guidance that can support a school in its drive to be more successful in its work.

A number of educators, architects, and designers have worked to articulate the needs of the modern learning space. David Thornburg in his book, From the Campfire to the Holodeck, puts natural terms around the need for classroom design. Though not biomimicry at its core, it approaches the spirit of biomimicry as it is an approach that seeks solutions by emulating nature's patterns (Thornburg, 2014).

Thornburg (2014) outlines four basic classroom design models, campfire, watering hole, cave, and life. Each serving a distinct purpose in support of whole child learning. Thornburg was definitely looking for ways to bend the concept of learning space and remind educators that much is to be learned beyond the classroom.

The campfire is the place where students gather to hear the wisdom of the expert. The telling of story is an essential human experience, and oral tradition of learning has long been the dominant force in passing truth, safety, and ideas from generation to generation. The campfire concept calls for the storytelling to be rich in nature and hopefully the sharing of knowledge can be diffused across all learners, both lead learners and neophytes.

The watering hole is the place for social learning. This space allows for dialogue to grow as a way to help knowledge grow sticky. The social aspect of education draws us into communities of learning that realize that the wisdom of the room always supersedes the knowledge of one. Classroom watering holes have clusters of seating that allows for groups to gather by design to discuss, solve, and iterate.

The cave is the home of reflective learning. This often looks like reading nooks or a place where students can escape the noise of the classroom or life. It can also be a place for reflection. It is the place where a quiet moment allows our brains to thread together concepts. It is a place where it grows quiet, so the connections grow strong. It helps our introverts recharge, and it allows for students to practice the value of silence.

Life is the final space. Life spaces are experiential in nature. They can be digital and physical, and they can allow students to create, make, and design for real-world audience. It is in life that students find their passions, connect with fresh experts, and begin to cross the bridge into school as life and life as school.

Thornburg (2014) wraps the concepts of place-based learning, biomimicry, design, and best instructional practices into a complex package. He is steps away from calling for educators to look to nature for the classroom design needs of the modern learning experience. The conversations, design, and research of this work is looking to take this next step in pushing for classroom design solutions that bolster learning through natural solutions. In order to do this, we proposed one overarching concept and three project questions.

PROJECT QUESTIONS

How would nature solve this? This question is central to this project, and it focuses the work on a set of solutions already found in the natural world that can be transferred into solution making around the needs of the modern classroom. While this question is central to all conversations of biomimicry, this work will also be shaped by three statements that have emerged from the work of the Cloud Institute for Sustainability Education (2011). These statements are: organisms are exquisitely adapted to their homes and to other organisms, nature has already solved the problems that we are trying to solve, and biomimicry occurs where ecology meets agriculture, medicine, materials, science, energy, computing and commerce.

This general question and the three statements above supports the following three project questions.

- How does the language of biomimicry support change in classroom design?
- What types of biomimicry based solutions resonate most with learners?
- In what ways, can biomimicry based solutions support engagement and joy in learning?

These questions will be explored through the examination of the following six areas that appear to have potential classroom design solutions baked into their current natural truth: erosion, river flow, sunsets, nests, waterfalls, and fire.

EROSION

The study of erosion has led biomimicry researchers to find ways to preserve coastal lands from flooding as well as landscape design, and we now are looking at how it can impact classroom design as we think about ways to break the normal flow of students in order to maximize cooperation and communication in the classroom. All classrooms have natural traffic patterns caused by the design of the space, but the study of erosion allows us to solution make around ways to break the inertia of the classroom movement to better retain students in positions that best support longer opportunities for student-to-student communication and collaboration.

RIVER FLOW

There is a tradition on American rivers to attempt to control a number of factors about the natural flow of the body of water. This includes attempts to control flooding, depth of the river for transportation purposes, and diverting water for consumption and irrigation. All of these efforts have had mixed results, and lead to an examination about how the wisdom of both the successes and failures in this realm can inform classroom design. The physical configuration of the classroom can feel like a learning lock and dam system that holds up, raises, and lowers. Is there some wisdom to be found in the removing the classroom design obstacles that resemble the barriers that we used to inhibit river flow.

SUNSETS

The natural beauty of sunsets can inform how we use color and light in our classrooms. Biophilia, a term first coined by E.O. Wilson in 1984, is the innate desire to be connected to our environment and other living things, and that connection to nature and maintaining alignment with its rhythms, including natural light/dark cycles (USAI Lighting, 2016). Sunsets provide a specific type of light that impacts mood and connections. Additionally, the study of sunsets and the combination of colors that they produce speak into the need for an appropriate color palette in classroom design.

NEST

The protection of children is central to the concept of nests, and classroom design also has safety and protection as an important role. Classrooms can comfort by enveloping children with spaces that are comfortable, caring, and quiet. The nest protects, and the nest helps with the growth process as young birds live in community until they are ready to launch into a different phase of life. Classroom design can mirror this support.

WATERFALL

Tremendous energy comes from the waterfall, and waterfalls create continuous change and remove the stagnation of water. Waterfall produced energy that reverberates into the surrounding ecosystem as well. Classroom design has opportunities to learn from all of these areas. In an era of learning that demands high energy and agility, the biomimicry solution opportunities from the waterfall and its surrounding ecosystem could guide a new type of classroom design that features intentional ways to help students with change and create positive energy throughout the learning space.

FIRE

Extending on the campfire concept that Thornburg (2014) names in his modalities, fire is a natural attraction and place of focus. Fire draws us closer for warmth, for inspection, and for community. Fire also has a way of clearing out the underbrush so all that remains are the essentials in the forest. We can use these solutions from nature to think about classroom design and what the density needs are in the classroom. Is the underbrush too thick?

The natural solution to classrooms design doesn't come from having more desks. It means thin classroom walls that utilize the natural environment and resists the opportunity to be sheltered from the greater ecosystem. Nature calls into question the effectiveness of things like grade, tests, and standardized curriculum, and it calls on us to draw students into the center of every decision. (Presnitz, 2017).

PROJECT DESIGN

This design journey has a primary focus around the creation of a learning space at Brittany Woods Middle School (MO). This space is being designed with the project questions and concepts above central to the work. The hope is that what is learned through this process will expand and scale across the district. The project is collecting three types of data.

CHANGE LANGUAGE

Part of the change process in education begins with the shift of the language used to describe a situation. At the beginning of a typical solution making process, individuals are quite varied in the language that they use to describe a situation. This lack of common language can lead to unfocused and miscommunicated situations that inhibit solutions. This project is looking to infuse the language of biomimicry into the design conversations with teachers and students throughout the project. The rapid design and quick iterative nature of this project allows for measure of language change over time to see if there is greater coherence around preferred classroom design language.

ROOM DESIGN PROCESS

The concept, drawing, design, purchase, and staging of this classroom design can be greatly influenced by the project questions and the concepts of biomimicry. Students and teachers will be co-designing this process, and they will have an opportunity to consider the six areas described above as well as unpack the project questions and guiding concepts as a part of the early design and revision process.

As the space is launched for use, this project will continue to study how the biomimicry based solutions are utilized in practice. Successful learning that promotes engagement and joy may or may not come from the solutions outlined in the design process. No matter the composition of any design group, there is some level of design for and not with the actual individuals that use the space. This area of data collection will look to see if the solutions' designed become central to the function of the space.

LIMITATIONS

The core idea is that nature has already solved many of the problems in which we grapple. Animals, plants, and microbes are the consummate engineers. Being that this work is bringing biomimicry concepts to individual classroom design, limitations abound. These include: project design, structure of the project questions, the ever growing complexity of limiting the classroom variables for measurement, and the sample size of the students and teachers involved in the work. Other research on biomimicry or the use of the principles of biomimicry wander away from classroom design to overall school design or architectural design which limits this study from being able to speak into or generalize any of that work to a greater degree as well.

CONCLUSION:

"Biological organisms have, for the past 3.8 billion years, had the time to perfect their systems to work interdependently. We can look at those systems, see how they've been optimized and then look at human-created systems," said Tim Gaidis, sustainable design practice leader at St. Louis-based HOK, a worldwide architectural design firm (Baugher, 2011).

The intentional design of the learning space at the Brittany Woods Middle School in the School District of University City will build a learning habitat that gleaned wisdom from the natural world. Design through biomimicry is not a new phenomenon, but as it relates to learning space and classroom redesign, there are great opportunities for students, teachers, leaders, and the community to grow their knowledge about how the solution of the natural world can be replicated in both new design and retrofit design in schools. As we ask for greater change in the physical spaces in which students learn, it is important that we grow common language, design with purpose, and measure the impact of the usage. Using the ideas of nature as solution maker is one lens that seems to allow for a greater coherence among all involved.

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The spirit of 'WE' in learning environments:
'WE LEARN'- a space for students and teachers to become.

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ABSTRACT

This project advances the idea that enhancing the spirit of collective culture, called 'WE', vs. the spirit of individualism, called 'I', in learning environments, for students and particularly for teachers, is necessary for 21st Century learning places. Both of these cohorts use learning, working and doing processes, and are facing major changes from educational mandates. A 'WE' cultural structure could be designed to support multiple aspects of collaboration and creativity, where hub-specific solutions empower the two groups as collectives and supporting a 'WE LEARN HUB' setting. Connecting practice to research, a glance at a process of change in school design related to the 'WE' culture is presented through an academic park, built in Israel, which uses an introductory design of the hub's setting approach, supporting the 'WE' of both communities.

Anat Mor-Avi is an experienced architect, artist and currently a PhD student at the Illinois Institute of Technology, the College of Architecture in Chicago USA. In the last 20 years, she has focused on designing learning environment facilities in the USA and Israel while empowering the interrelation between the evolving pedagogies and the physical surrounding. Challenged by building with bricks and mortar for dynamic education, Mor–Avi returned last year to the academic world in order to thoroughly investigate the connection between Architecture, Interior Design, and Education. Her research topic is studying how architectural and design attributes contribute to students and teachers success while supporting and enhancing Creativity and Collaboration. This research will focus on the spirit of 'WE' among faculty and among students as well as between the two entities, vs. today's spirit of 'I' in learning environments. As an architect involved in current projects while researching the field, a unique opportunity has emerged for her to tie practice with research and to analyze the projects she was involved in, by investigating the users' experience. This final step in the quest of designing innovative learning environments for today's dynamic education is a goal for this research.

BACKGROUND

In the past, the goals of education and the design of learning places were based on a homogenized factory-like model (Scott-Webber, 2004). The new model of the 21st century's education practices advocates the creation of knowledgeable and adaptable people who can develop and share new knowledge with others and influence a new economy (Robinson, 2011). Passive learning is gradually being replaced with active learning to enhance the motivation, curiosity, creativity, and collaboration skills in students.

The idea of learning as a dynamic, multi-directional process, which acts as a social and playful process creates a challenge for defining spaces for learning geared toward   certain activities while opposing past centuries' point of view modalities. It is suggested here that we need to explore wider ideas and agendas - as author Jos Boys (2011) introduces in her book Toward Creative Learning Spaces; learning is not a linear process (see Figure 1)
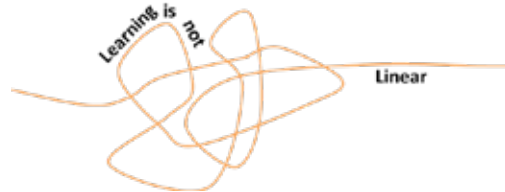

Figure 1: Learning is a dynamic process (adapted from Boys, 2011).

Students and teachers today are in a constant learning process. As a result, education is evolving to enhance successes while taking into consideration how we learn and ways to enhance students' and teachers' collaboration and motivation (Boys, 2011).

According to the psychologist Keith Sawyer (2007), creativity is always collaborative, and organizations that want to change for the better should be encouraging collaborative group settings, moving to team organization, enhancing their own reserves of creativity and distributing leadership. In his book Group Genius, Sawyer (2007) refers to many innovations that affect our lives, which emerge from group genius. The unique power of collaboration generates unique interacting opportunities resulting in a string of successive ideas - each spark lighting the next and enhancing creative solutions and innovations.

"When we collaborate, creativity unfolds across people; the sparks fly faster, and the whole is greater than the sum of its parts," writes Sawyer (2007, p.7). In an effective creative community, innovation emerges over time and from the bottom up, enhances deep listening that helps build ideas as extensions of the ones before, and transforms ideas to good questions and outcomes (Sawyer, 2007).

In his book, Participatory Creativity, Clapp (2017) claims that creativity, like learning, is a social process circulated through the class by participation, not a process that happens in isolation. He also argues that reframing the understanding of creativity, as a socially distributed process is a necessary first step ensuring greater numbers of students can gain access to creative learning experiences through which they will develop their creativity further. Collaboration is central to creativity (Clapp, 2017). Robinson (2011) adds to the argument suggesting, "creativity is about connections and is usually driven more by collaboration than by solo efforts" (p. 211). Therefore, it might be important for schools to develop cultures of creativity.

Moreover, the fact that technology and knowledge about how we learn impact learning and the learner, suggests that social values in schools become of greater importance (Scott-Webber, 2014). Empowering each cohort's community (i.e., students and teachers) in school as two collaborative groups of learners might be the basis to encourage and build a 'WE' community. However, the culture of the collaboration of teachers and students in learning environments is in constant flux. This process is complex and includes many old paradigms that may need to be abandoned by the students, the teachers and the entire community (Scott-Webber, 2017).

Students are being encouraged to collaborate and learn to become team members instead of being passive listeners. Those changes, however, are challenging because of longstanding assumptions that traditional environments are crucial to serious learning and success. The design of Meitar High School (HS) provides an example to illustrate this point. Meitar HS in Israel is equipped with 'dynamic furniture' in all classes to support the option for dynamic settings. However, according to the school principal, some students and teachers still consider the traditional row-setting as the more serious and secure learning layout model – a clear indication of behavioral conditioning (Scott-Webber, 2004). According to the principal, it is relatively challenging for higher grades students and educators to adopt new changes after being exposed for years to a traditional education methods and settings. How might these changes begin to happen?

TEACHERS: FROM LONELY SUPERHEROES TO GROUP WISDOM

A starting point for change is the teacher, and some of the best resources for teacher success are their colleagues. Some schools adopting multidisciplinary pedagogical strategies embrace a culture of teamwork and collaborations similar to that of the corporate world. However, physical spaces in schools currently do not accommodate collaborative work between teachers. In the 21st century, teachers are a community of learners and the teacher's tendency to work and teach in isolation is no longer suitable and/or effective (Glaze, 2014). After a history of closed doors and teaching done in the teacher's way, in 'my classroom' it is essential that teachers have the time, space and incentives to collaborate like any future-oriented organization (Hattie, 2009).

Building a learning culture based on collaboration – a 'WE' environment – could be a powerful catalyst to boost morale, improve interactions, and establish a culture of collaboration. Spatial types designed to encourage collaborative work, invite new types of interactions and serendipitous collisions among students, is needed.

STUDY OBJECTIVES

The objectives of this study will include these questions:

1. How might these more advanced changes for learning and teaching strategies be addressed through architectural and/or design solutions?
2. What architectural attributes, impact learning experiences specifically related to the social connections supporting collaboration and creativity?

DISCUSSION

THE MEANING OF 'WE' ESPOUSES THE ARGUMENT FOR COLLABORATION, CREATIVITY, AND LEADERSHIP FROM INSIDE-OUT

There is a perceived need to empower both teachers and students. Therefore, it is essential to investigate the potential of enhancing the spirit of communal culture, called 'WE' for each group, vs. the spirit of individualism, called 'I', particularly for teachers (see Figure 2). Student success is being investigated through changes in education methods, and innovative spaces are being designed that enhance teamwork and collaboration, the teacher's spaces do not reflect those qualities, but rather illustrates one of isolation (Scott-Webber, 2017).
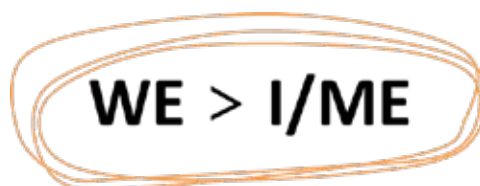

Figure 2: The WE>I/ME concept.

The 'WE' concept correlates with the idea calling for education to be treated as a public domain. This idea suggests no one individual, or a specific teacher's controls this domain. By joining the collective wisdom and self-organizing dimension of each community in the school, the 'WE' concept is enabled to move forward (Art of Hosting, n.d). People give their energy and provide their resources to what matters most to them. Therefore, the 'WE' concept has the potential to empower (a) peer gathering, (b) task or interest-related connections, and (c) collaborating in informal and formal knowledge sharing places supporting increasing complexity in educational practices and creativity.

The school is where learning and working converge with two major groups of users in different doing and learning modes. The qualities of progressive, creative workplaces and innovation labs that enable learning by collaboration and knowledge sharing should become infused into 21st-century learning places. Thinking, learning and doing should be made more visible, and the notion of the user experience (UX) of formal learning is then supported in an informal setting.

The main message in John Hattie's (2009) book *Visual Learning*, is that what works best for the students is similar to what works best for teachers. Visual learning is one of the fundamental pillars of openness and sharing in education that enhance the connection and the network between learners of both groups.

This suggestion is being supported by Franklin Covey's (as cited in Fonzi, 2011) program's principles, "The Leader In Me," which is based on three beliefs: (1) Everyone in the school community is capable and has the choice to become an opinion-leader regardless of his/her role, (2) To be an effective person regardless of age, and (3) The relation which ties inspiring creativity and leadership of teachers. Covey's idea, which he defines as inside–out leadership, emphasizing the importance of empowering the collective culture.

Therefore, the spaces enabling a 'WE' culture should provide capabilities for collaboration and interactions as well as leadership without a hierarchical culture. The ability for the teachers to collaborate could become a model for the students. Thus, transparency between the spaces could support and be considered an educational tool.

In the process of change, we can observe evidence of the evolution of alternative spaces beyond the classroom for collaboration among students. On the other hand, almost all spaces provided for the teachers do not support teachers' collective community. Accordingly, a model, which further supports the collectives, is introduced as 'WE'.

CREATING HUBS FOR STUDENTS AND TEACHERS: A POTENTIAL MODEL

The 'WE' cultural structure may offer spatial formations optimizing innovative approaches to learning and working. One idea is to have innovative labs for each group, with a shared space in between, to support the students and teachers development together as facilitators and team players. This type of place could be designed by creating informal and formal settings for both users and breaking down the visual barriers between all for promoting visual thinking, learning and working, as in many organizations and innovation labs around the world. Informal contexts may suggest much less formal settings and options for outside school encounters.

Therefore, when considering school design perhaps as a three-place learning hub model, with special interactions areas designed between informal and formal settings may occur as follows: Informal hubs are designed to support a:

1. Students' hub for learning and doing
2. Teachers' hub for working and learning
3. Formal hub as an interconnecting hub designed for both students and teachers to connect and collaborate; the '2+1 WEHUB' (see Figure 3).
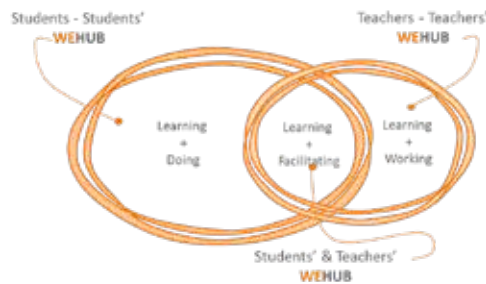
Figure 3: The 2+1 WEHUB Model.

The '2+1 WEHUB' model creates the opportunities for the students and the teachers to increase the potential for operating as two groups, independently and jointly. Accordingly, the spaces reflect each collective need while the third-place hosting both collectives for working together. Simultaneously, rescheduling of the school day is needed to accommodate the needs of each group to empower its collective.

The process in school design, which responds to those dynamic needs and changes, will be discussed through an example of a three-school Academic Park located in Israel, representing the evolution of the collaboration culture in schools.

A GLANCE ON A PROCESS OF CHANGE IN PRACTICE

AN ACADEMIC PARK IN GANEY TIKVA ISRAEL- FROM SMALL GESTURES TO NEW PARADIGM

In Ganey Tikva, a fast growing township in the center of Israel, an Academic Park (GTAC) is being developed, which includes a library-incubator for innovation, an elementary school, a middle school, and a high school. Despite the fact that the Ministry of Education, reflecting its strict and traditional program, finances schools, an opportunity to observe the gradual change in the physical environment is evident. In early 2016, Elyot Elementary School (1st -6th grades) was opened and offered a small common area for alternative study between the traditional classrooms (see Figure 4).

Figure 4: GT academic park: Eylot Elementary School 2015.

In September 2016, the first stage of Meitar HS (9th -12th grades) was opened offering open classrooms as study halls for students to collaborate. The surroundings offered some transparency qualities of the teachers' areas and homerooms. Also, all classrooms were equipped with flexible furniture and accessories inviting sharing ideas and collaboration (see Figure 5).Meitar HS which was chosen as a lab for future pedagogical strategy innovation by the Educational Ministry, promoting a unique experimental future-oriented curriculum for teachers, students, and the community. The school's pedagogical principles are Collaboration, Listening, and Responsibility. All communities involved in the school activities are expected to become open source for all. Moreover, collaboration among faculty has been encouraged, and a set of expectations applied to establish more connections.

Figure 5: GT academic park: Meitar High School 2016-17.

Some issues impacted the design of the middle school. It is to be connected academically to Meitar HS in the future. According to the head principal of Meitar HS, the teachers who are open to change and embrace the collaboration culture most are second career teachers who bring qualities from different disciplines and positions from the high-tech culture. In Meitar HS, 64% of teachers joined the educational field from other disciplines. This reflects a phenomenon in Israel where according to the Central Bureau of Statistics; more than 25% of the teachers come from the high-tech arena to join the educational system of 1st to 12th grades. Therefore, it is necessary to provide them with spaces reflecting the collaboration qualities to which they are accustomed and help them lead the change.

Further factors impacting the design include informal responses from senior educators of the Research & Development Department at the Israel Ministry of Education, which have been gathered to shed light on the desirable qualities for teachers' and students' 'WE' culture formation. They are as follows:

1. Students' 'WEHUB' should have qualities of makers' workshop with physical and mental opportunities for connections and collaboration.
2. Teachers' 'WEHUB' should support an informal gathering space as 'kitchenette time' and non-schooling functions to encourage communicating, working, and resting in settings which enhance the principle of participatory leadership introduced by Toke Moeller the co-founder of "Art of Hosting" (Art of Hosting, n.d).
3. The interconnected 'WEHUB' should have the qualities of a mentoring hub with different scales of encounters.
4. Using motivating terminology

Accordingly, the middle school planned for 7th to 9th grades and its design reflects the '2+1 HUB' model. This school, which will be inaugurated in 2018, will adopt meaningful strategies toward the culture of change in learning. A new concept of arrangement was introduced where all areas, which are not homerooms, will be functioning as hubs for learning. This 'WEHUB' will include 'WE LEARN' areas for students and teachers on the same floor with visual connections (see Figures 6-8).

Figure 6: GT Academic Park: Middle School 3th floor; WEHUB plan.

Figure 7: GT Academic Park: Middle School 3th floor; WEHUB bird eye view.

Figure 8: Students & Teachers WEHUB.

CONNECTING PRACTICE TO RESEARCH

Changes in school design are reflecting the new approaches to learning instead of teaching and the accepted wisdom about how we learn. Studies in the science of learning have shown that student success occurs while being active and engaged socially in a meaningful process (Ambrose, Bridges, DiPietro, Lovett, & Norman, 2010). The goals of the new qualities in the physical learning environments are to support the teachers to create learning qualities, which reflect those needs. However, adopting changes is a complex process to all users, and therefore, a need to evaluate the connection between education and design is necessary (Imms, Cleveland, & Fisher, 2016).

To connect practice to research, the schools in the Academic Park will be evaluated through qualitative and quantitative measures. In particular, the research will focus on how visible learning and thinking can be empowered by the '2+1 HUB' model.

Figure 9 presents a timeline indicating the evolution in the Academic Park's schools and the issues that connect practice to future research.
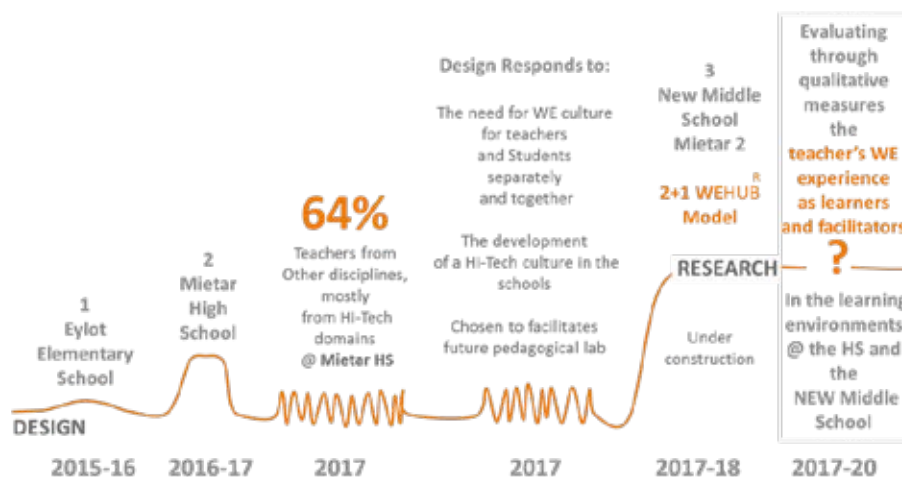

Figure 9: Connecting practice to research-time line.

SUMMARY

This paper discusses the benefits of enhancing the spirit of 'WE' for teachers as well as students vs. the spirit of 'I' in learning environments. The art of collaboration among students and teachers as separate groups that are combined at times is being considered as an essential skill for both groups.

Ganey Tikva's Academic Park, which includes three schools following in tandem, was introduced as an example to demonstrate the distinct tendency in the development of the informal learning and working environment areas for students and teachers. Moreover, based on the phenomena in Israel where more than half of the teachers are joining the educational system from a corporate-collaboration culture, the paper suggests responding to teachers' particular need for environments that support and empower their abilities to perform as a collective. Accordingly, a 'WEHUB' like setting was introduced in the third school, the middle school, enhancing visibility, supporting noticing the moment and the opportunity, encouraging people to stop and think and boosting attitudes, creativity, and hopefully the wisdom of the collective.

The new design principles related to the '2+1 HUB' model will be evaluated as part of a dissertation, through the lenses of the user experience of both collectives in the Israeli middle school opening September 2018.

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Session three: Change and risk
Interlocutor

Dr. Julie Marshall
Winthrop University - United States

Dr. Julie Marshall serves as a 7th Grade Language Arts teacher at Saluda Trail Middle School and an Adjunct Professor in the Richard Riley College of Education at Winthrop University, both located in Rock Hill, SC. She has over 25 years of classroom experience at the elementary/middle school levels in conjunction with 7 years at the university level. Julie has won many awards for exemplary teaching on the state and national level, including National Teacher of Excellence and selection as a Global Teaching Fellow. She helped develop an endorsement for teachers of students from poverty and actively helps to shape policy and practice in her state. Julie is a National Board Certified teacher and evaluator. Currently teaching in a STEAM/P21 exemplar school she is a strong proponent and practitioner of Project Based/Active Learning Environments. She was one of the inaugural recipients of the Steelcase Active Learning Center grant program. Dr. Marshall has provided local, state and national professional development on the use of PBL and Active Learning in the 21st century classroom.

Julie's research and practice has been devoted to linking motivation and interest to student success. Her action research is helping other teachers re-discover their passion to teach as she challenges them to design/configure learning spaces to better meet the needs of individual learners. Her research data shows the positive impact active learning environments have on student motivation, work completion, and academic achievement.
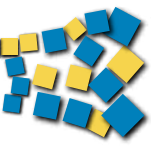
Aligning vision with actual use of innovative learning environments: Explored through the lens of organizational change

Taryn Elyse Kinney
Columbia University - United States

ABSTRACT

To answer the question, "What steps need to be taken, from an organizational development/Change Leadership perspective, to ensure Innovative Learning Environment's (ILEs) are used as intended?", I focused on Glenn High School. I used two methods to explore causal relationships between steps-taken and the achievement of behavior change. I first analyzed the process that campus principal Arturo Lomeli used to open the school, and found that a clear Change Leadership process, aligned with the original vision, was utilized. I then interviewed eight members of the campus planning team utilizing the Burke Litwin Organizational Assessment Survey (Burke, 1998). Results showed participants were highly-aligned around transformational areas of the survey. Findings suggest that strong and consistent leadership, in conjunction with a proven Change Leadership process, may explain Glenn's success in change. Comparison of assessment survey data of additional successful and unsuccessful schools may allow a more comprehensive understanding.

Twenty years ago Taryn decided to study architecture because of the fascinating intersection between perception, sensory stimulation, and the emotions a spatial environment evokes. She found her passion in educational facility design. Incorporating developmental research and changes in pedagogy into the design discussion became Taryn's specialty. She developed her process to respond to clients' need to explore and define their future approach to learning. After all, if a building is going to last fifty years, it needs to flex to support changes in teaching and learning. Taryn has led a dozen transformational visioning processes, and then designed new environments to support this future learning. However, only a handful of these projects were ultimately utilized to the potential of the original vision.

Frustrated by the difficulty to transition and sustain change, Taryn realized that her clients needed support not only in environment design, but also in organizational design. In this vein, Taryn recently completed a masters in Organization Psychology with a specialty in Change Leadership from Columbia University's Teachers College. Research completed at Columbia started the development of a holistic service that couples change leadership and organizational design with environment design.

Educational built environments are one of the only space types that have remained relatively stagnant over the last century. Residential, retail, and workplace environments have constantly evolved to support changing ways in which we operate. If you look at a classroom from the early 1900's it looks very similar to a classroom of today with four walls, one teaching wall with a teacher desk nearby, student desks in rows, and no visual connection beyond that singular space. Likewise, the pedagogy of teacher-driven, direct instruction has remained the most prevalent delivery method despite research that offers a multitude of more effective ways to approach and facilitate learning.

Because of the large economic investment that accompanies the design and construction of new school facilities a great urgency to address change arises in the initial planning phase for a new facility. An increasing amount of time is invested to define a future-oriented Vision, often resulting in aspirational goals to use new pedagogies in non-traditional learning spaces, termed *Innovative Learning Environments* (ILEs) by Imms et al., (2015). These spaces are characterized as being multi-modal, technology-infused, and offering flexible layouts. While extensive research has looked at the design of ILE's, little empirical research has explored the transition from traditional environments to new ILE's (Blackmore, Bateman, Loughlin, & O'Mara, 2011).

Multiple studies exist that provide a good argument for the power of our built environment to affect behavior, and therefore confirm Lewin's Field Theory, B=f(P,E) or that Behavior is a Function of People and their Environments (Marrow, 1969). However, I have anecdotally experienced many examples of new Innovative Learning Environments not changing behavior campus-wide.

LITERATURE REVIEW

In my literature review, I searched for examples of culture creation, organizational design, and/or change leadership tied with new environments. I was able to find examples of changing culture, for example: through bottom-up teacher collaborative efforts (Dana 1993), overcoming resistance to change within education (Heath & Heath, 2011), and the relationship between leadership and culture (Turan & Bektas, 2013). However, none of these resources related to systematic or transformational change in relation to a campus-wide built environment change.

Based on the lack of existing research tying these variables together in education, I began to look for workplace examples. This search quickly yielded multiple instances where the built environmental was changed with intentional adjustments made in the organizational environment ultimately resulting in changed behavior. Miller, Casey, & Konchar (2014) in their book *Change Your Space, Change Your Culture* describe a variety of organizations including Cummins, Inc., Google, W.L. Gore & Associates, and CBRE that have either grown or changed cultural norms and behaviors while making a facility change. One idea, that arguably started at Google, has permeated the field of workplace design is that of 'casual collisions'. Dave Radcliffe, vice president of Real Estate and Workplace Services for Google, states that "Casual collisions are what we try to create in the work environment. You can't schedule innovation, and you can't schedule idea generation. So we really look for little opportunities for our people to come together" (Miller et al., 2014, pg. 164). This idea is implemented on the facility side by providing transparency and openness that enable employees from different teams to see idea generation, and engage quickly and effectively. Proximity of dispersed micro-kitchens also allow employees to come together quickly and casually in support of innovation creation. To encourage coming together Google provides private buses and other ways to get to work, but not allowing work from home or tele-commuting. In the CBRE example, the crash of 2008 created a strong urgency to reimagine space and cut costs. However, through strong leadership from President Lew Horne and engagement of employees the reinvention became an exploration of "efficiencies of space for the employee experience" in lieu of squeezing costs (Miller et al., 2014, pg. 167-168). Employees went on tours of new, innovative work spaces, and small test areas were created to explore new furniture and technology. There was a process of co-creation between CBRE leadership and design consultants. CBRE was able to navigate the culture and organizational challenges while designers created the spaces to support those changes. Through these steps and support provided to employees along the way including "digital coaches", "CBRE went from private offices, cubicles, and conference rooms, to over 16 different kinds of configured spaces." (Miller et al., 2014, pg. 172).

Becker and Steele (1995) in Workplace by Design dedicate the second half of the book to how to launch, champion, and implement a Vision for a new workplace design. They enforce the importance of leadership's "ability and willingness…to point the way by shaping and consistently supporting the change process", and to "articulate a vision of how the facilities might contribute to improved organization performance" (Becker et al., 1995, pg. 173). They go on to outline a change process with eight steps that could be loosely associated with Kotter's eight-step process of change or Pasmore's Model for Leading Complex, Continuous Change, if the iterative part were stripped away, see Table 1, (Kotter, 1996; Pasmore, 2015).

Based on these findings, I hypothesized that Lewin's Field Theory could be broadened to reflect that Behavior is a function of both the Built Environment and the Organizational Environment, B=F(P, Eb+Eo), (Table 2). The Built Environment includes spatial qualities, furniture, technology, and tools within. The Organizational Environment is a system with inputs and outputs and it includes leadership, mission, culture, and supporting systems.

The conspicuous lack of successful examples of Change Leadership occurring related to education facility design contrasted with a multitude of examples in workplace facility design reinforced the importance of this research. I decided to focus on a positive example of when the Vision for a new campus had been achieved or, at a minimum, the school was in process of attaining the Vision. I chose Tom Glenn High School in Leander, Texas designed by Pfluger Architects. School principal Arturo Lomeli is an enthusiastic advocate of Change Leadership and a willing partner to help answer the following question:

> What steps need to be taken, from an organizational development/Change Leadership perspective, to ensure Innovative Learning Environment's (ILEs) are used as intended?

Table 1: Comparison between three independent change process models.

WORKPLACE BY DESIGN CHAMPIONING THE WORKPLACE VISION	KOTTER 8-STEP MODEL FOR CHANGE	PASMORE MODEL FOR LEADING COMPLEX, CONTINOUS CHANGE	
Setting Direction	Creating Urgency	Discovering	Stepping Back
			Scanning
Defining Key Challenges	Build Guiding Coalition		Visioning
Setting Feel of Organization	Getting the Vision Right	Deciding	Diagnosing
			Focusing & Prioritizing
Monitoring	Communicate for Buy-in		Scoping & Designing
Initiating Projects	Empower Action	Doing	Communicating
			Engaging
Tracking & Review	Create Short-term Wins		Piloting & Implementing
Setting Policy	Don't Let Up	Discerning	Aligning & Integrating
			Assessing
Modeling	Make Change Stick		Adjusting

Table 2: Modified Lewin Field Theory with proposed measurements for each variable. Desired behaviors from Glenn High School Vision. Behavior surveys occurring outside of this research.
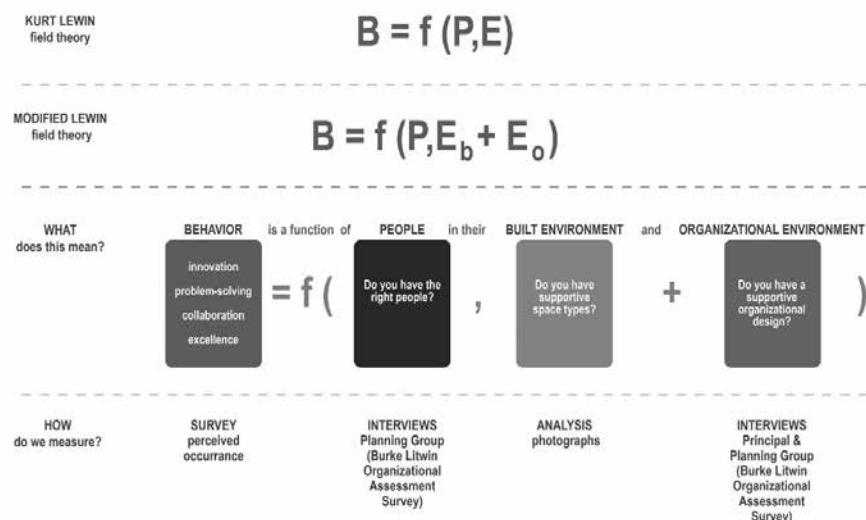
CONTEXT OF THE ORGANIZATION

Leander Independent School District has 38,000 students attending forty-one campuses located northwest of Austin. Leander's population is more highly educated and has a higher income than Austin proper. 18.59% economically disadvantaged district student population as compared to 30% economically disadvantaged population at Glenn High School (Population and Survey Analyst, 2016). The school district has had the rare benefit of long-tenured superintendents bringing stability to the district as a whole. Dr. Bret Champion, superintendent at Leander ISD during the design of Tom Glenn High School, shared that prior superintendent, Tom Glenn, had established a culture of continuous improvement. Glenn proved to be a strong mentor to Champion.

Dr. Champion shared that the design process for Glenn High School was a departure from traditional design for three reasons. First, district administration had completed transformative work developing the *Seven Student Learning Behaviors* and the supporting *Learning Model*, they did not however have facilities that supported the achievement of these behaviors. Second, the district had experienced great success in designing two elementary schools with Innovative Learning Environments. Lastly, district administration learned during the design of the elementary schools how easy it is to slip back to traditional learning models, creating a misalignment with the new ILE. Based on these experiences, Champion provided the organizational framework to support the shift to ILEs, data to back up this decision, and a strong commitment to align space and use.

Champion's long tenure empowered him to take risks and be trusted by his team to challenge the status quo. Champion hired a new Chief of Staff and then the new principal for Glenn High School prior to his departure from the district. These two individuals had opened new campuses previously together which helped create a supportive organizational environment.

RESEARCH METHODS AND RESULTS

My hypothesis: If you have the right <u>P</u>eople, a supportive <u>B</u>uilt <u>E</u>nvironment, and a supportive <u>O</u>rganizational <u>E</u>nvironment, <u>B</u>ehaviors will change (Table 2). In this case, the desired behaviors are directly identified in the Vision of Glenn High School -- *Innovation, Problem-Solving, Collaboration*, and *Excellence*. The <u>B</u>uilt <u>E</u>nvironment is supportive of these behaviors in the following ways. First, the classrooms are organized into small groups, or academic neighborhoods, that intentionally mix teachers from different disciplines to drive *innovation*. Second, instead of teachers being assigned to particular classrooms teachers are assigned to an academic neighborhood with a variety of space types to utilize.

Figure 1: Teacher shared work area/ Professional Planning space beyond.

Figure 2: Large student collaboration areas at center of learning neighborhood.

Teachers have a desk in a shared work area which facilitates *collaboration* among teachers and supports the development of non-traditional activities like co-teaching and cross-curricular projects, (Figure 1). Additionally, the shared academic neighborhood supports teacher collaboration around the success of all students not just those in his/her class. Third, each academic neighborhood offers an open, large collaboration area with flexible furniture, technology, and, most importantly,

space to explore, build projects, and *problem-solve*, (Figure 2). Lastly, windows between interior classroom walls and large group collaboration area places learning on display. This connectivity holds teachers and students accountable which, based on anecdotal research in other schools improved outcomes or *excellence*.

The two variables, B̲ehavior and the B̲uilt E̲nvironment, of the Modified Lewin Field Theory are established and in alignment at Glenn. Exploring the causal relationships between the remaining two variables P̲eople and O̲rganizational E̲nvironment, informed the research approach. Principal Lomeli and I co-created the research design to include two parts.

First, I would document and analyze steps taken in his Change Process. Second, we would utilize a modified version of the Burke-Litwin Model for Organizational Performance and Change (Figure 3), with associated questions from The Burke Litwin Organizational Assessment Survey to diagnose success and areas for improvement within Glenn High School's organizational design.

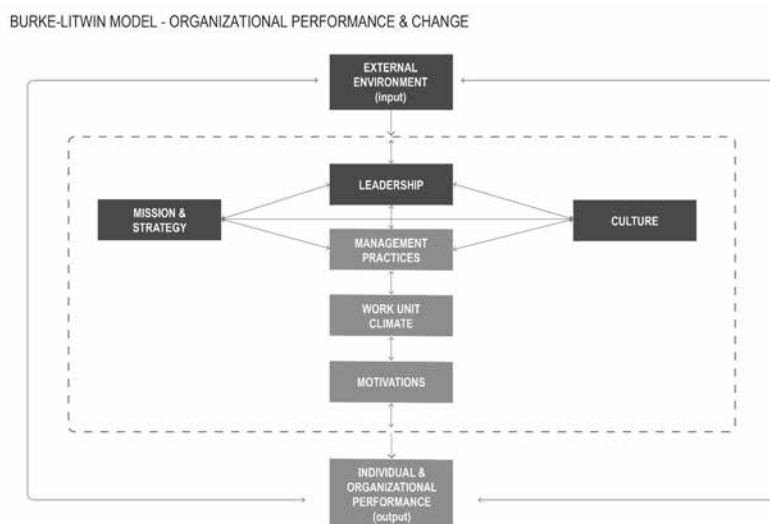BURKE-LITWIN MODEL - ORGANIZATIONAL PERFORMANCE & CHANGE

Figure 3: Figure adapted from the Burke-Litwin Model of Organizational Performance and Change. This paper references the transformational components, or dark gray boxes. Complete research also included the spine of the model.

Change Process Analysis. Analysis showed that Lomeli's methods of leading change tracked to Kotter's eight-step model. Kotter's **Step 1- *Increase Urgency*** started with Champion prior to Lomeli's hire. However, the resulting new built environment added urgency to change behaviors both for Lomeli and his new team. In response to **Step 2- *Building the Guiding Coalition***, Lomeli intentionally hired individuals that bought in to the Vision of the new school. He explicitly invited applicants to assess their personal values with those of the organization and the change effort at hand. This step aligns with research from Klein & Sorra (1996) when they correlated employee commitment to "the perceived fit of the innovation to employees' values" (cited in Choi, 2011, pg. 484). In response to Kotter's **Step 3- *Get the Vision Right***, Lomeli spent his first months understanding the Vision of the stakeholders and the design team that came before. He developed, in a participatory manner with his Planning Team, how this Vision could be met. Lomeli didn't allow what Bion describes as basic assumptions or resorting back to the comfortable past to occur (1961). In fact, at the beginning of the summer prior to the start of school, he implemented **Step. 4- *Communicate for Buy-In***. He invited his faculty to answer, "What kind of culture do we want at Glenn High School?" During this phase of culture creation and relative ambiguity, Lomeli engaged in "Sense-giving". He communicated his version of practices that would achieve the vision by giving a copy of the book "What Great Teachers Do Differently" by Todd Whitaker to each of his faculty and staff. Finally, Lomeli and his Planning Team created an exhaustive public relations process to communicate the Vision at each feeder campus and to the broader community. Lomeli implemented **Step 5- *Empower Action***, by placing high value on people and communicating that their input/actions mattered. In this vein, he implemented Participatory Design by assigning members of his Planning Team to each develop a particular part of the Vision. Additionally, **Step 6- *Short-term Wins***, are celebrated every six weeks with grade-level celebrations. Gratitude Passes were also created to celebrate "Doing the right thing" and can be awarded from teacher to student, student to student, or student to teacher.

With a reflective practice in place, **Step 7.** *Don't Let Up* is baked into the process. Feedback occurs in monthly faculty and Planning Team meetings, and one-on-one meetings between Lomeli and each Planning Team member. **Step 8.** *Make Change Stick*, is currently underway, and is supported with the culture of continuous improvement that Lomeli has continued from former Champion and Glenn.

ASSESSMENT RESULTS

I interviewed seven members of Glenn High School's Planning Team: Administrative Assistant to the Principal, Associate Principal, Dean of Instruction, Assistant Principal, Head Counselor, Athletics Coordinator, and Band Director. One month later, I interviewed Lomeli. I asked the following questions from The Burke Litwin Organizational Assessment Survey (Burke W. W. 1998):

1. How would you describe the educational marketplace/environment? Is it relatively stable or rapidly changing? (EXTERNAL ENVIRONMENT)
    2. How clear are people (staff, students, parents) about Tom Glenn High School's direction? (LEADERSHIP)
    3. What words or phrases would you use to describe the current strategy of Glenn HS? How is it trying to achieve its central purpose? (VISION + STRATGEY)
    4. What seems to drive people in the organization? What is it that consistently gets their attention? (ORGANIZATION CULTURE)

To process the results of the interview, I identified and coded common themes within each question response.

Overall, the aggregated responses showed clear alignment in the four transformational areas External Environment, Leadership, Culture, and Mission & Strategy. Responses to the first question regarding the external environment affirmed that the right people were in place to lead transformational change. Fifteen out of twenty-two comments focused on the dramatic and continuous change occurring in the world of education, and the value of continually learning and improving, or having a change mindset, in order to stay current with that change.

Four themes emerged in response to Leadership, Mission & Strategy, and Culture. The most mentioned topic related to "Building a Community Greater than Self". Utilizing Simon Sinek's Golden Circle as a frame for understanding, this theme could be described as the driving force, or the "why" of Glenn High School (Sinek 2009). The idea of building a community that is bigger than the individual student or campus is understood by moving students beyond "academic excellence" to "evolving into a members of society" (Planning Group, personal interviews, Jan. 20, 2017). This definition of Excellence, which is part of the school's Vision, allowed faculty, staff, students, and community to have a driving goal that united them.

Creating "Buy-in at all levels" to the Vision was the second most mentioned topic, and can be understood as "how" they will "Build a Community Greater than Self". This buy-in was achieved through regular reiteration of the Vision by district leadership, Glenn, Lomeli, and the Planning Team. When Lomeli would introduce a new teammate he would describe how that individual would directly contribute to the Vision. Regular reiteration of the school Vision continued through organization design, and informed professional development around the four pillars of the Vision – Innovation, Collaboration, Problem-Solving, and Excellence. Students were introduced to the Vision through a one-week orientation at the start of school that specifically focused on culture creation.

Additionally, Lomeli created multiple "artifacts of culture" that drove home the Vision and completed Buy-in (Schein 2010). During the visits to feeder schools, Lomeli handed out orange T-shirts emblazoned with the Grizzly mascot, and introduced the hashtags #PaintLeanderOrange and #GrizzlyGrit+3, a direct reference to their culture framework. When arriving to the campus, a visitor is first introduced to the Vision through the address on Collaborative Way (Figure 4). Next, the mascot is introduced before entering the building through signage in the parking lot (Figure 5). Banners throughout the school reiterate the Vision of Innovation, Collaboration, Problem-solving, and Excellence (Figure 6). Finally, the school seal with the four Vision points, is seen daily on the primary stairs of the building and is awarded in a lapel pin form for academic excellence (Figure 7).

The third most mentioned topics answers the "what" of the Golden Circle (Sinek 2009). Glenn High School will meet their vision through *Reflective Practice and Maintaining a Change Mindset*. For each challenge that the Planning Team addressed they were "looking for not just the obvious answer, but what could be more effective, with a larger impact, and be more successful" (Planning Group, personal interviews, Jan. 20, 2017). They realized that in order to "stay on top of a new and unstable environment" they must be "constantly questioning and going above and beyond." This commitment to continual improvement provides a defense to resorting back to traditional teaching methods.

Figure 4: Example Artefacts of Culture. Main entry of school located on Collaborative Way.

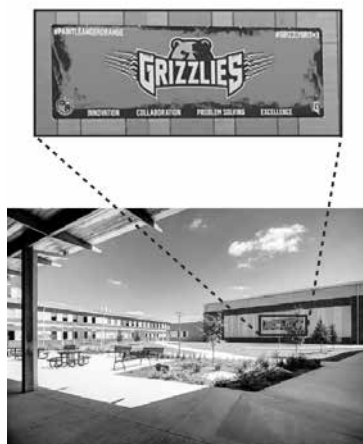Figure 5: Mascot introduced prior to entering building.

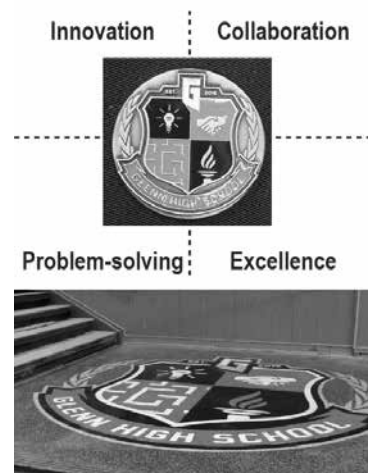Figure 6: Banners located throughout school reiterate Vision.

Figure 7: School seal reiterates 4 parts of Vision located in daily path of school inhabitants.

IMPLICATIONS

The change process that Lomeli is working through at Glenn High School is successful not only due to his strong leadership, but also because he has implemented a culture of constant improvement. Through this culture, and the work we did together for my ACP, I believe that Lomeli and Glenn High School could shift from Kotter's seven steps to an iterative model of Continuous Change (Pasmore, 2015) for improved results.

This project is the first step in answering a question that many of my clients have asked me: "I know the world of education is changing and I know we need to change, but how do we change?" Change Leadership is desperately needed, and yet the field of Change Leadership and even the terminology is unfamiliar in both industries in which I work—education and architecture. By building on the research started here, I will develop a transitional design tool kit built through the lens of Organizational Development and Change Leadership. This service will ensure that ILE's are utilized as intended. If this can be achieved, millions of dollars invested in built environments will provide a much needed return of more engaged learners.

Lewins' Field Theory, B=f(P,E) is not wrong. However, the variables of *People* and *Environment* have multiple facets. In order to change behaviors in new built environments, and benefit educators and learners alike, we need to carefully design the organizational environment to support the same goals as the built environment.

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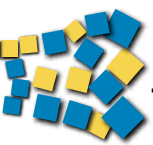
School change: Emerging findings of how to achieve the "buzz"

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ABSTRACT

This paper explores emerging findings from the research question, "What characterizes a successful transition of a school from traditional classrooms to an innovative learning environment in the context of the design and construction process?" Many schools today are trading in their identical classroom model for activity-driven, technology-infused spaces and envision a future in which teaching, culture, and space align seamlessly resulting in the intangible "buzz" of engaged learning. However, research and experience show many of these schools fail to supplement the design and construction process with initiatives to align teaching practices, organizational structures, and leadership with the intended vision. This often results in a misalignment between the pedagogical goals of the building and its subsequent use. To provide a research-based course of action for transitioning schools and basis for future PhD study, exploratory case studies were completed of schools who are in new buildings and have achieved the "buzz" resulting in emerging best-practice processes and tools.

Raechel earned a BED in Architecture and a BS in Psychology from Texas A&M University and a Masters in Human-Environment Relations, with a focus on Facility Planning and Management, from Cornell University. In her professional work as an educational planner in the United States, Raechel finds that many school designs upon occupation fail to live up the their envisioned potential. Her goal is to help expand the role of school architects and planners and better align the use of a new facility with its intended vision through work at the organizational and pedagogical level. This research was completed as a Fulbright Postgraduate Scholar as part of the Innovative Learning Environments and Teacher Change project at the University of Melbourne. This work will be integrated into her subsequent PhD studies with the University of Melbourne's Graduate School of Education

INTRODUCTION

ALIGNMENT OF SCHOOL DESIGN AND USE

When categorizing spaces by the alignment of pedagogy and design intent, four scenarios emerge (Figure 1). One represents the "*status quo*" in which teachers teach with predominantly direct instruction in a school with a traditional design (for example, double-loaded corridor, identical classrooms, rows of desks facing a teaching wall). The reverse of this is what this paper deems "*the buzz*" in which teaching is predominantly student-led and multi-modal in a school with an innovative learning environment design, or ILE (defined as being multi-modal, activity-based, and technology-infused). There is also the "*square peg, round hole*" scenario in which there is student-led teaching and learning occurring in a traditional space and the "*wasted investment*" scenario in which there is an ILE-design but still predominantly teacher-led, direct instruction.
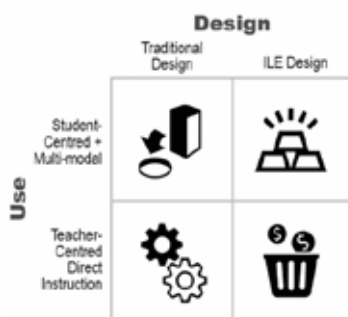

Figure 1.

Experience and research show many schools end up in this "*wasted investment*" quadrant in that they've invested in new spaces but have not yet invested in new teaching practices (Saltmarsh, Chapman, Campbell & Drew, 2015). Through case studies answering the question, "What characterizes a successful transition of a school from traditional classrooms to an innovative learning environment in the context of the design and construction process?" this research seeks to identify strategies to help schools and teachers transition from the "*status quo*" to "*the buzz*" while avoiding "*wasted investment*".

LITERATURE REVIEW

Anecdotal experience in the school design industry shows a consistent lack of focus on the transition into new spaces. This is validated in the literature as there is ample focus on the design and little regard for the "implementation and transition phase" (Blackmore, Bateman, O'Mara, & O'Loughlin, 2011). This same literature review identified seven areas requiring further inquiry, three of which will be addressed throughout the PhD research of which this paper is the first step: "the processes and preparation required to transition…the types of practices that emerge in new spaces… (and) the organisational cultures and leadership that facilitate or impede innovative pedagogies" (Blackmore, et al., 2011, p. v). Experience and literature also show that teaching and learning often remains traditional and explicit despite inhabiting new space types with broader teaching and learning potential (Saltmarsh, et al., 2015). This is anticipated to be due to lack of focus on organizational structures, leadership relationships, and teacher professional development. Previous research completed on school design often ignores these factors and literature on whole school change in turn ignores impacts of school design.

It is important to note that this research is not a focus on the design of space itself nor its impact on teaching and learning. Research here is well covered and ongoing (Barrett, Davies, Zhang & Barrett, 2015; Blackmore, et al. 2011; Cleveland & Fisher, 2014; HEFCE, 2006). Instead, this paper operates under the assumption that the design team has created a space that, if used as intended, has the potential to function properly in regards to pedagogy, acoustics, technology, air quality, and lighting, among others. The focus instead is on the transition process implemented to shift the school organization and support educators to align their practices with the intended functions of the new space.

RESEARCH DESIGN

The research question, "What characterizes a successful transition of a school from traditional classrooms to an innovative learning environment in the context of the design and construction process?" aligns with Yin's (2014) scope of a case study in that the phenomenon of school transitions is a contemporary, real-world phenomenon highly impacted by its organizational, social, and political contexts. Further, the features of a case study also apply in that multiple variables (rather, the characteristics of the transition) overlap and thus, multiple sources of evidence connected through theoretical basis are required to properly triangulate data and come to valid conclusions. The research process was both reflective with examination of the previous design and transition process and real-time with examination of the ongoing transitional efforts being made in the early years of occupying the school.

The unit of analysis is the entire school or in the case in which only part of the school was redesigned, the portion of the school residing in new space. The teachers' are an embedded unit of analysis. The transition process includes, but is not limited to, the following elements: leadership, professional development, educator perceptions, presence and type of students, teacher, stakeholder, and community engagement; and, strategic messaging. The initial bounds were fluid here due to the exploratory nature of the case studies.

SITE SELECTION

To successfully answer the research question, participating schools must have 1) a new[1] ILE design; 2) been initially staffed with teachers used to teaching in traditional settings; 3) an indication that it is operating as intended or on track to do so (rather, on track to achieve "*the buzz*"); and, 4) the ability to provide access to documentation of the design and transition process. Case study sites were selected and these requirements operationalized through a survey conducted by the Innovative Learning Environments and Teacher Change (ILETC) research project led by the Learning Environments Applied Research Network from the University of Melbourne (Imms, Mahat, Byers, & Murphy, 2017). The main research question of the ILETC is "Can altering teacher mind frames unlock the potential of innovative learning environments?" (ILETC, 2016). A central component of this research is the relationship between types of learning environments, teaching practices, teacher mind frames, and student deep learning (Imms et al., 2017).

The ILETC survey was completed by 822 school principals and/or leaders throughout Australia and New Zealand and classified the school's physical environment design and measured its teacher mind frames, the presence of student deep learning, and teaching approaches, among other items (Imms et al., 2017). ILE design was determined by respondents indicating a learning space type of C, D, or E[2] from Dovey and Fisher's spatial typologies (2014). Above-average means for teacher mind frames and student deep learning and having a predominantly student-centred teaching approach were used as indicators of likely successful operation. An internet search on schools fitting the criteria was completed to rule out schools who were not residing in new facilities. A subsequent telephone census was conducted with schools fitting these criteria to identify if teachers had come from traditional settings and documentation of the design and transition process was feasible.

In total, four schools were selected for case studies, one of which contained multiple, separate ILE sites. Two of the schools were located in Australia and two in New Zealand. One was a Catholic school and the others government schools. They support communities of varying levels of socio-economic backgrounds and are all at different points of their transition with some more established than others. Some are brand new schools to support population growth and others replace existing facilities. Regardless, all schools were trying to take teachers from traditional teaching in traditional facilities to successfully inhabit an innovative learning environment.

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1   Two of the case study sites were within their first 2 years of occupation. One opened in 2011 and another in 2009. Participants in the older school were involved prior to opening and the design and transition process was well documented.

2   Type C - Traditional classrooms with flexible walls and breakout space; Type D - Open plan with the ability for separate classrooms; Type E - Open plan with some adjoining spaces

METHODS

Participants from each case study site included teachers, school leaders, and school designers. A total of 20 teachers, 4 school leaders, and 3 designers have participated to date. Teachers participated in a focus group consisting of a transition game (figure 2), the creation of a Journey Map (figure 3), and completion of a letter written to a future teacher transitioning to an ILE. This focus group format was developed through workshops as part of the ILETC and tested through a pilot study at a school in Victoria, Australia. Images of these tools can be found in Figures 2 and 3. Teachers also participated in a one-on-one interview following the focus group. School leaders participated in an interview and led a tour of the school. School designers, which encompasses architects and/or educational planners or members of the establishment board, participated in an interview. This paper represents initial thematic analysis from the interviews and focus groups. Further more refined open coding and theoretical sampling will be undertaken along with follow-up interviews and supplemental data collection. A document analysis will also be completed on key vision, planning, design, and communication documents disseminated during the design process and initial occupation. These multiple-methods will allow for the necessary triangulation and hope to further substantiate these emerging themes.
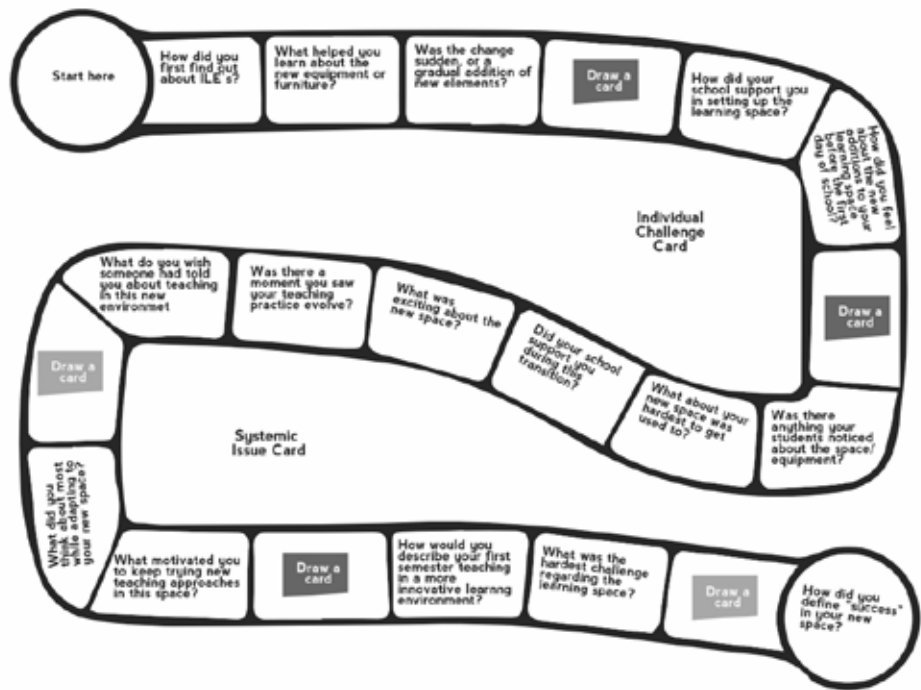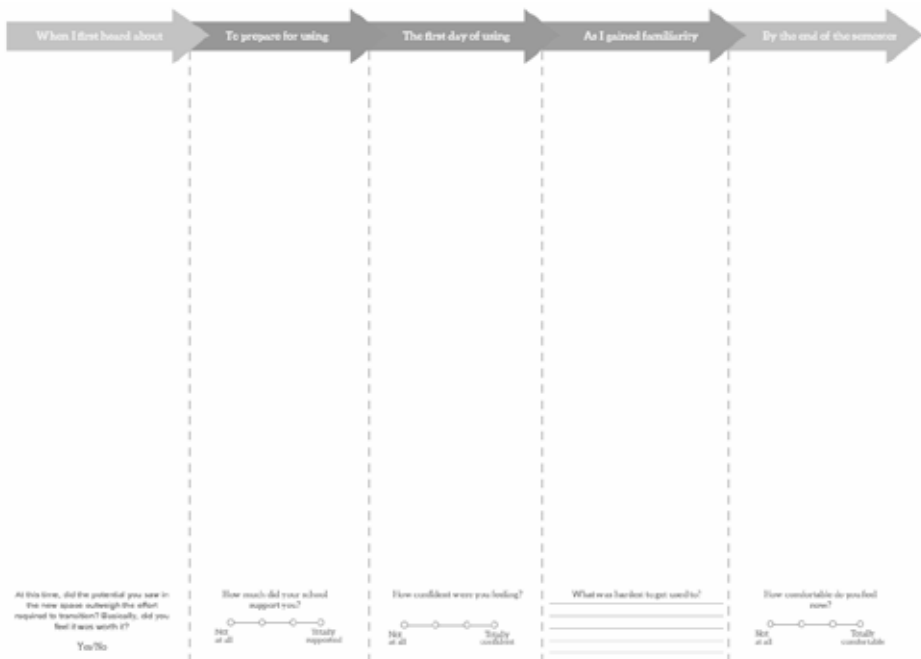

Figure 2.

Figure 3.

DEFINING THE 'BUZZ'

Defining success is not a goal of this research. Instead, this research sought to understand the alignment between what the school wished to see as success and the subsequent reality of the space and its use. Thus, one of the questions asked of all research participants was how they define success in these new spaces. When asked this, many participants described what this paper calls "*the buzz*" or rather, the palpable presence of student-driven, engaged learning. The following interview quotes are indicative of the conversation around the definition of success in an ILE.

> "…it's the start of the unit where they're going off and doing a bit of searching about something they're interested in - there's a real buzz in the room and I think that's a sign of success"

> "The measure of success is in how it "just works". Sometimes it's not tangible. But the place is always alive and buzzing…I see a really cohesive group of people working together for the benefit of the students and that's, that is tangible."

> "It's like an idling engine so it kinda just hums along and (teachers) don't have to be there for it to go like that but when (they) want it to accelerate then that's where (teachers) come in."

> "(success is) that one on one individual, moving around…it's the hum of learning together and discussing and you think, where's the teacher?!"

The "*buzz*" is not a prescriptive term yet it elicits clear understanding regarding what expectations and activities underlies the word. It also lends itself as being broad enough to encompass an array of pedagogical goals of a school. Many things can result in the "*buzz*"; it is not created through the building itself but in the inhabitation of the facility and its corresponding culture, leadership, organizational structures, and teacher mind sets that coincide.

EMERGING THEMES

This paper reflects findings from early stages of analysis of exploratory case studies. At the moment, themes are aligning into three categories: pre-occupation enablers which are steps schools took before moving into their new facilities, organizational enablers which represent the ongoing cultural, leadership, and structural variables, and spatial enablers which are moments in which the spatial design itself plays a key role in helping teachers and students shift their practice. It should be noted that there are few clean breaks between themes. They interrelate with one another as the pre-occupation steps help set the stage for the culture to take hold or the space to have the leverage required. Further, their effectiveness depends on many moderating factors. Unpacking this process will occur through future PhD research.

Pre-occupation enablers included prototyping space and pedagogy, forming clarity around the purpose of the spatial design, and indoctrinating the "why" of the design through research. Organizational enablers included establishing and embedding a shared language, focusing on relationships between teachers, between teachers and students, and between students themselves; maintaining a culture of risk; and purposeful structure across each level of the organization. The latter is what this paper is calling "layered scaffolding" and is explored in more detail below. Spatial enablers included transparency and openness allowing for visible teaching, on-going authentic observation, and implicit student behaviour management. The sense that spatial inflexibility could nudge a teacher to shift pedagogically also arose from the data.

AN EXAMPLE STRATEGY: LAYERED SCAFFOLDING

Present in the successful narrative of case study sites was an ongoing process at the moment called "layered scaffolding". This is the notion of providing the ideal amount of structure at each layer of the organization so that the level below experiences 'just enough' guidance to allow innovation to flourish. The government level, which may be the Ministry of Education or the establishment board, provide structure over which the principal was appointed and mandated to innovate. This may be the school design itself and/or a prescribed pedagogical direction, among other possibilities. The principal and other school leaders establish timetables, evaluation metrics, or other non-negotiables that align with this vision and provide a basis through which educators can have autonomy over their courses. These educators then establish routines for students

or leverage purposeful relationships to guide student behaviour and allow appropriate amount of choice and self-regulation in their learning. One school leader interviewed summed this concept up well by saying "If you want the freedom at the student level then you need to be super structured up top".

In schools or learning spaces in which such scaffolding was not done, or structure was not provided, teachers created their own which would trend towards the traditional. This concept aligns with recent work by Saltmarsh, et al. (2015) on structuration in which teachers, when perceiving a lack of order, imposed their own inflexible spatial practices and didn't make best use of either the space or materials. "Teachers see the imposition of (their own) additional structuring of both lessons and the daily timetable as the most appropriate pedagogic response to what they perceive as a lack of order" (Saltmarsh, et al., 2015, p 322).

One example of such 'layered scaffolding' is a strategy employed by one of the schools to assist teachers in modifying their pedagogy. This principal, when preparing teachers to inhabit a school with a prescribed vision of team teaching and spaces with flexible, non-traditional furniture developed a series of expectations for educators through the language of David Thornberg's archetypes (Thornburg, 2001, revised 2007). These archetypes compare learning spaces to campfires, watering holes, caves and the like and provide a shared language for space and were used as part of educators' cultural and spatial induction. These archetypes were incorporated into teachers' lesson planning, ongoing classroom management, and their own evaluation. With the expectation of their students sharing this language as well, some teachers created tangible icons, manipulatives, and displays. The discussions of space were thus ingrained in the daily operations and routines and became effective proxies for the envisioned pedagogy and student behaviour. For example, students knew that when they were in a "Watering hole" they should not just be socializing but sharing knowledge. Teachers as well were being challenged by leadership to reduce their "Campfire" time which effectively guided them from less lecture to more student-centred instruction. This use of archetypes as structure was effectively change management in disguise.

This strategy aligns with recent work on the sociomaterial view on the inhabitation of space in which "New school buildings matter...as effects of materializing processes in which school personnel and objects take part. The building gives the principal above 'licence...to ask those bigger questions' and to 'crowbar' the process of curriculum and pedagogic change" (Mulcahy, Cleveland, & Aberton, 2015, p. 10). The space is linked to text, technology, and artefacts in a circulatory fashion as pedagogic change and spatial change come to being together.
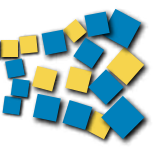
NEXT STEPS AND FUTURE APPLICATION

The themes and examples presented here reflect early findings from initial thematic analysis and form the basis for future PhD research. This future research will include further and more in-depth analysis into these same case studies with additional case studies to be completed in Australia, New Zealand, and the United States. The goal is to translate identified themes and strategies into applicable tools school leaders, teachers, and school designers can use to help teachers transition practice. These tools will be piloted and disseminated at scale to test their efficacy as part of the ILETC research study (ILETC, 2016). This paper's research question is especially suited to the creation of tools to be applied alongside the design process of the ILE, leveraging most intensely the often under-utilized period during construction to assist with the forthcoming transition. When done right, the goal is for schools to find their "buzz" sooner, rather than later.

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The built pedagogy of K-12 personalized learning programs as designed opportunities for student voice and choice

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ABSTRACT

The design of the physical spaces are an important - yet often overlooked – component of learning. In prior research on K-12 personalized learning programs (PLPs), our team found that teachers had radically modified their classrooms and buildings, from knocking down walls to adding sofa chairs and lamps (Halverson et al., 2015). The stark contrast from the expected desks in a row, prompted the question: How does the design of physical spaces in PLPs provide opportunities for student voice and choice? In an instrumental case study (Stake, 1995) of four PLPs, I draw out design affordances (Norman, 1994) from patterns of teacher and student use in order to understand the complexity of physical spaces, pedagogy, and student agency. Four meaningful patterns of use emerged: spaces designated by purpose, flexibility in student movement and furniture, regular assembly of a local learning space, and students as co-designers. Each of these affordances aligns with choices students have over their learning process and even points toward potential mechanisms for developing agency and community. Most research on flexible learning environments in personalized learning ignore the physical spaces, but these findings argue for their consideration in any pedagogical model. This challenges educational leaders to see spaces as a built pedagogy and what reflect on what their learning spaces communicate to teachers and students about what learning looks like and who is valued. To be sure, physical spaces do not solely determine student learning experience, nor is changing physical spaces a panacea to enact pedagogical change, nor was it my goal to quantify the effect of physical spaces on learning outcomes. What this study illuminates are the ways the physical space is connected with students' voice and choice by design.

INTRODUCTION

The design of the physical learning spaces[1] are an important - yet often overlooked – component of what it looks like to learn in school. In prior research on in personalized learning programs (PLPs), our team found that teachers had radically modified their classrooms and buildings, from knocking down walls to adding sofa chairs and lamps (Halverson et al., 2015). The stark contrast from the expected desks in a row, prompted me to ask: *How does the design of physical spaces in PLPs provide opportunities for student voice and choice*? In an instrumental case study of four PLPs spanning kindergarten through 12th grade, I draw out design affordances (Norman, 1994) from patterns in teacher and student use in order to understand the complexity of physical spaces, pedagogy, and student agency.

LITERATURE REVIEW

The design of the physical learning space combines architectural and educational values and assumptions into a "built pedagogy" (Monahan, 2002, p.5). In traditional, egg-crate building model of K-12 schools, the built pedagogy is teacher-centered: teachers are assigned to a classroom and set of students; students sit in rows of desks facing the board, where the teacher will stand and deliver knowledge; and assigned seats and bells control student movement and bodies. In contrast, personalized learning is an increasingly popular, student-centered pedagogy that seeks to engage students in their own learning process (Rickabaugh, 2016). Flexible learning environments are included as a key component, but this is generally considered to be classroom culture, instructional strategies, and digital and online spaces, not the physical spaces (Cleveland, 2009; Patrick et al., 2013). The progressive pedagogical methods of Montessori and Reggio Emilia have long considered the importance of the "prepared environment" or Third Teacher, going beyond built pedagogy as a reification of values and assumptions and treating physical spaces as a source of learning (Edwards, 2002).

The physical spaces of schools are also overlooked in learning theory. The seminal constructivist text, *How People Learn* (National Research Council, 2000), makes no mention of where learning happens. Embodied cognition is beginning to coalesce (Wilson, 2002), but this focuses on individual learning, not situated in a community or school. Attention to buildings in K-12 rose briefly with the open school movement of the 1970s and is resurging now, though researchers then and now have failed to recognize the complexity of environment-behavior relationships (Weinstein, 1979; Woolner, 2015). Recent studies have been primarily in higher education (Strange & Banning, 2001) focused on active learning spaces and mobile technologies (Oblinger & Lippincott, 2006).

CONCEPTUAL FRAMEWORK

One way to conceptualize the physical spaces is through the lens of design. From this perspective, all objects have *features*, which the designer builds into the object (Norman, 1994). The features reflect and embed the voice, values, and assumptions of the designer. When the object is used, its *affordances* increase the likelihood of particular uses. Use, however, is socially constructed, and the intentions of an object or space do not always match use (Pinch & Bijker, 1984). Observing patterns of use reveal the affordances.

RESEARCH DESIGN

I focus exclusively on personalized learning sites because this is where educators are actively modifying their physical spaces. I selected a subset of four personalized learning programs (see Table 1) as an instrumental case (Stake, 1995) from a larger ongoing, multi-site phenomenological study (Halverson et al., 2015) in order to examine this question in

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1   *Physical environment* generally refers to structures, materials, and sensory stimuli, such as natural light through the windows, water quality, and ambient temperature. Although physical environment and physical space are often used interchangeably, I use physical space to capture both the elements and overall composition. For example, this would refer to the layout and type of furniture, the size, and the coherence with which it all fits together.

more depth. The sites represent a range of grades, enrollments, and building configurations. Balsam High and Carson Middle provide examples of smaller programs within a larger, traditional school. Delaney Middle and Edison Elementary provide examples of large, whole-school programs. All are public schools and built their spaces within existing buildings.

Table 1: Study sample.

Name	Level	Type	Location	Students	Free & Reduced Lunch
Anderson	HS	Magnet school	Urban	1000	60%
Balsam	HS	District charter	Suburban	150	20%
Carson	MS	School program	Suburban	100	40%
Delaney	MS	District charter	Suburban	800	20%
Edison	ES	Neighborhood	Urban	450	50%
Franklin	MS	District charter	Rural	100	20%
Grant	ES	Neighborhood	Urban	450	70%
Hillside	ES	Neighborhood	Urban	350	70%
Irving	ES	Neighborhood	Rural	350	25%
Irving	MS/HS	Neighborhood	Rural	300	30%
Jackson	HS	District charter	Suburban	100	30%
Kingston	MS/HS	District charter	Urban	70	65%

Table 2: Description of each program of the subsample.

School	Location	Organization of Space	Features	Origin Stories
Balsam HS	Within a legacy high school	By arrangement	Flexibility Visibility Permeability	Charter within a large legacy high school with the goal of influencing change through proximity.
Carson MS	Within a legacy middle school	By purpose	Central teachers' hub Flexibility Visibility	Program within a legacy middle school. Took over underutilized space.
Delaney MS	Whole-school	By purpose	Permeability All spaces are learning spaces	Whole-school charter. Took over unused, existing school building.
Edison ES	Traditional neighborhood school	By arrangement	Variation Permeability	Whole-school. Required to accommodate increasing enrollment.

I collected data through observations (n=27), interviews (n=27), and focus groups (n=32 students). In observations, I attended to teacher and student movement throughout the space, specifically where they went and what they did. I triangulated observations with teacher and leader interviews and with students in focus groups until saturation (Guest et al., 2006). Schematic drawings of building arrangements were used to draw comparisons across sites. I coded all data deductively using a multi-level framework (Halverson et al., 2015). The cross-section of *learning environment* and *agency*[2] revealed 50 instances that were then inductively coded for patterns of use and student participation in building the spaces themselves.

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2   "Voice and choice" emerged as a common practitioner phrase later in our work. Agency was the initially created code and then kept for consistency.

FINDINGS

The patterns of use across the four PLPs were: spaces designated by purpose, flexibility in student movement and furniture, regular assembly of a local learning space, and students as co-designers. All four programs designated spaces by the type of learning or activity: performance, media production, commons and informal "hangouts," reading nooks, among others (see Figure 1). In the multi-age, co-taught classrooms at Edison Elementary, teachers carved out purpose-based spaces within the same room (see Figure 2). At Balsam HS, Carson MS, and Delaney MS, these were separate rooms across the building that students had open access to throughout the day. Designation of spaces by purpose decenters the voice of the teacher, and centers the learning process.

Figure 1.

Figure 2.

Throughout the school day, student movement to, from, and within these spaces was both organized by and independent of schedules. Traditional programs restrict student movement, delineating times that students are in desks and signaling transitions with bells. In contrast, these programs allowed students to move as needed, whether to change tasks, get resources, or simply get a drink of water. To coordinate movement across multiple spaces, both middle schools installed QR scanners that allowed students to check in and out of spaces independently.

The flexibility of the furniture also amplified choices about where to learn and what this looked like. All four programs had group spaces with moveable seating, such as "node chairs" (see Figure 3), as well as areas with a cushion on the floor, café height tables, or couches. Choice is an act that happens in tension between the affordances of the design and the agency to make and act on options (Bandura, 1999). When students have opportunity to move and make choices, they are agents in the learning process. For all its flexibility, the layout of the furniture structured movement in ways that provided coherence and rhythm. While a student presented to a small group, another student sat reading, tucked into a couch but facing away. Teachers found that "with open spaces ... you still need quiet areas to focus," so they created nooks or quiet rooms.

Figure 3.

Elementary classrooms took "brain breaks" together, during which they did stretching and balancing exercises, made possible by the larger open spaces. One kindergarten boy was lying on his back, sunk down into a small sofa chair, legs straight up in the air, working on his iPad, challenging what learning bodies look like. Two Edison teachers reported that individualized education programs (IEPs) that specified movement breaks were no longer necessary because students could move their bodies when they needed. Movement is a critical part of child development and without opportunities to move, students have trouble staying focused and learning. Students shared that "We like [that] we can pick where we go" and "You can go into an environment [where] you work better ... I work well in an open space area where people are passing by." Furthermore, students regularly negotiated where and with whom to learn, necessitating social interaction, a fundamental process for building community (Bickford & Wright, 2006).

The purpose-based spaces, flexibility of furniture, and movement meant that students and teachers had to regularly reassemble their local learning space. Younger students stacked up their iPad, book, and pencil case; moved to a new space; then unstacked and arranged their materials around them. Older students often stayed in one space for longer, spreading out notebooks and a laptop across a table, bringing along food and water. Teachers also taught in different places throughout the day, so they modeled this process. When meeting one-on-one with students, teachers sometimes discussed the impact of student choices about where to learn. These opportunities to make choices plus guided, metacognitive reflection develops the self-knowledge and self-regulation students need to learn (Schraw & Gutierrez, 2014).

Finally, all four programs engaged in some degree of co-design with students. Students at Delaney, for example, used a spring break to paint and organized a new art classroom. The principal regularly "crowdsources and vets" ideas with students. Carson teachers survey students, track use, and regularly iterate on furniture arrangement so as to meet student need and desire. When students participate in the design of the space themselves, their voice and values is embedded into the physical space (Parnell, 2015), reinforcing student ownership, involvement, and participation in the learning process (Killeen, Evans, & Danko, 2003).

CONCLUSION

Considering physical spaces as a built pedagogy challenges the assumption that the where we learn matters and the dominant cultural assumptions about what learning looks like (Van Note Chism, 2006). Previous work on flexible learning environments has ignored the physical spaces, but these findings argue for their consideration in any pedagogical model. Design is a lens that may help educational leaders see spaces as a built pedagogy and what reflect on what assumptions and values their learning spaces communicate. To be sure, physical spaces do not solely determine student learning experience, nor is changing physical spaces a panacea to enact pedagogical change, nor was it my goal to quantify the effect of physical spaces on learning outcomes. This study focused on the way space is connected with students' voice and choice, even pointing toward potential mechanisms building agency and community. Further inquiry into the relationship amongst the elements of a flexible learning environment, such as schedule and instructional strategies should include the ways the built pedagogy hinders, supports, or amplifies student learning

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Session four: Measuring impact
Interlocutor

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Robert Talbert is an Associate Professor in the Mathematics Department at Grand Valley State University in Allendale, Michigan. He holds a BS degree in Mathematics from Tennessee Technological University, and MS and PhD degrees in Mathematics from Vanderbilt University.

Professor Talbert is a proponent and thought leader on active learning in higher education, particularly in the STEM disciplines. He is a frequent speaker and workshop facilitator on flipped learning, having authored several research papers on this subject and given talks and workshops across the US and in Canada, France, Jamaica, Spain, and the United Kingdom. He is the author of Flipped Learning: A Guide for Higher Education Faculty (2017) and is a Flipped Learning Research Fellow through the Flipped Learning Global Initiative.

Professor Talbert is currently on sabbatical from Grand Valley State University through August 2018, serving as a scholar-in-residence with Steelcase. In this position, he is consulting with Steelcase Education and the Workspace Futures group on active learning issues and conducting research studies on flipped learning.

Robert, his wife, three children and a variety of animals live in Allendale, Michigan where he enjoys cooking, bicycling, reading, and the beaches of Lake Michigan.

The creative learning spiral: Designing environments for flaring and focusing

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ABSTRACT

In the context of a rapidly evolving knowledge economy, creativity has become one of the most highly regarded qualities of a 21st century graduate, across age levels. Creativity appears as an attribute in Mehta and Fine's (2015) definition of deeper learning, and in the widely used rubric of the Four C's for twenty-first century learning (EdLeader 21). Research on the theory and practice of creative learning has stemmed primarily from the fields of psychology and pedagogy. This paper proposes an alternative lens for defining, designing and assessing creative learning experiences – through architecture and ethnography. Culminating the work of both head and hands, creative learning can be defined as an iterative process that lives through four modalities: sparking, making, grazing, and socializing. This spiral of activity maps onto a two-by-two matrix, with flare versus focus on one axis, and engagement with objects versus people on the other. This paper will summarize preliminary findings from design research conducted at Harvard's Graduate School of Design and the Harvard Innovation Lab. These findings test such a model as a rubric for designing and assessing learning environments for creativity.

Jane Zhang is a design researcher, entrepreneur, and lifelong learner. She is the CEO and Co-founder of room2learn, the first online platform for designing learning spaces. Jane leads a team of educators, design researchers, and software developers at the Harvard Innovation Lab. As a former educator, Jane has worked with youth in a variety of environments, from media classrooms to temperate rainforests. Prior to designing learning spaces, she worked as a journalist, urban planner, and in the clean technology sector. Jane holds a Master of Design Studies in Urbanism, Landscape, and Ecology from the Harvard Graduate School of Design and a BA & Sc in Sustainability and English Literature from McGill University.

INTRODUCTION

In the context of a rapidly evolving knowledge economy, creativity has been identified as a key survival skill for students in the 21st century. Tony Wagner defines creativity in terms of curiosity and imagination (Wagner, 2008). Jal Mehta and Sarah Fine, pioneers of the Deeper Learning movement, observe that "on the professional front", students "need to be able to tackle open-ended problems in critical, creative, and collaborative ways" (Mehta and Fine, 2015).

This paper draws on creativity literature from the fields of applied psychology and education. In the former, the field of creativity was long studied using the level approach, focusing on "understanding, predicting, and nurturing people's ability to produce novel ideas, solutions and products that served some need" (Puccio and Chimento, 2001). In 1976, Kirton introduced a departure from this method, proposing a cognitive style continuum that ranges from an adaptive to an innovative orientation [where] location along this continuum indicates the extent to which an individual will exhibit either a more adaptive or more innovative style of creativity" (Puccio and Chimento, 2001).

Within K-12 education research, the act of creation has been central to definitions of creative learning. Mehta and Fine (2015) see creativity as capturing "the shift from receiving the accumulated knowledge of a subject or domain to being able to act or make something within the field". Mitchell Resnick of the Lifelong Kindergarten group at the MIT Media Lab sees creative learning as a culmination of four Ps: project, peers, passion, and play (Schmidt, Resnick, & Ito, 2016). Architect Saeed Arida founded NuVu Studio, an innovation school for middle and high school students, to concretize the need to develop both *seeing* and *doing* in students. According to Arida, the creative process combines mindfulness with doing and is fundamentally social (Arida, 2010).

This paper aims to triangulate these previous conceptions of creativity from psychology and education studies with a spatial design perspective. How might creative learning be understood through the learner's use of space? Arguably, creative learning in the 21st century both requires and allows the physical learning environment to act as a teacher in facilitating learning. The creative learning spiral – a theoretical framework combining four modes of learning – is developed through the understanding of a learner's postures in space, and how one engages with people and objects in the learning process.

METHODOLOGY

The creative learning spiral was developed out of two studies, at the Harvard Graduate School of Design (GSD), and the Harvard Innovation Lab (i-lab) respectively. Within the author's campus environment at Harvard University, these sites were chosen for their relatively high concentrations of two types of creative work. The GSD exemplifies a traditional architectural studio environment, where students are tasked with projects to produce a variety of 2D and 3D models of space. The i-lab represents an increasingly popular typology on college campuses – the startup incubator, where students are provided a dedicated environment with resources to start and develop viable ventures.

The Harvard Graduate School of Design is one of the oldest design schools in the country. Architecture courses were first taught at Harvard University in 1874, and the GSD was officially established in 1936, combining three fields of architecture, urban planning, and landscape architecture. Today, its programs also include urban design, design studies, real estate, and design engineering. The aim of this multi-modal ethnographic study was to determine how GSD students define their work as designers. The primary method was participatory observation of the studio learning model throughout the course of one academic year.

Gund Hall, which opened its doors in 1972, was designed by Australian architect and GSD graduate John Andrews. Its primary feature is the collective studio space that extends five levels under a stepped, clear-span roof with natural lighting and views toward Boston. The central studio space is enveloped with a band of classrooms and offices on every floor. The main floor is home to a rotating public exhibition space, the Loeb library, and Piper Auditorium. The basement holds the stacks of Loeb library and the fabrication labs.
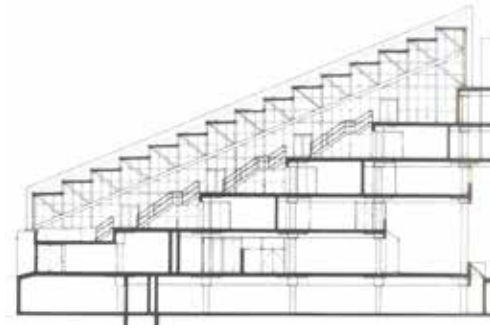
Figure 1: Gund Hall section drawing showing the central, tiered studio space.
Source: Marvel Building.

The second study explored student use of the Harvard Innovation Lab, an incubator for student-led startup companies, across Harvard's College and graduate schools. The i-lab occupies most of the ground floor of Batten Hall on the campus of Harvard Business School (HBS). Before it opened its doors as part of HBS in 2011, the building was previously home to WGBH's TV and radio studios, where Julia Child launched her career. The i-lab serves as a resource to foster collaboration and incubate ideas among Harvard students, faculty entrepreneurs, and members of the greater Boston communities through regular programming.

A random sampling of 21 students (out of 66 teams) in the summer cohort of the Venture Incubation Program were surveyed for their use of the space in relation to creativity, focus, and general productivity.

Figure 2: Axonometric 3D model of the first floor of Batten Hall, showing the Harvard Innovation Lab space. Source: Shepley Bulfinch.

Survey questions were designed to elicit user feedback about productivity, creativity, and general use of the incubator workspace. The following consist of a combination of quantitative and qualitative questions:

1. What do you like most about the space at i-lab?
2. What percentage of the time do you feel creative here? (e.g. generating wild ideas)
3. Where does that happen and what are you doing?
4. What percentage of the time are you able to focus here?
5. Where does that happen and what are you doing?
6. Where in the i-lab do you feel most productive? Why?
7. When do you feel most productive here? What are you doing in these moments?
8. Where outside of the i-lab do you like to work? What do you like about it there?
9. If you could change one or two things about the i-lab space, what would it be?

It was important to combine open-ended and closed-ended questions, to achieve depth and breadth in student responses. Students were asked to identify the percentage of the time they felt creative and focused on the space, and where and when they felt most productive in the space. These responses provided a quantitative baseline to form a community profile,

and were coupled with more open-ended questions for students to discuss their specific pain points, preferences, and suggestions for the space. As a side benefit, the survey provided an opportunity for respondents to reflect on their own work and study habits.

FINDINGS

GRADUATE SCHOOL OF DESIGN

The GSD study resulted in four steps of the studio learning process, each tied to an interior space typology.

1: Lecture Hall

The creative process for each studio course begins with *sparking*, or inspiration, from an expert figure. This mainly takes the form of lectures and guest talks, where a design luminary provides both context for a project and design direction.

Figure 3: Lecture in Piper Auditorium, Gund Hall, representing the first phase of the studio learning process. Source: Harvard GSD.

2: Site Visits

Once students are sparked with theory and background information, they conduct site visits to better understand the context in person. These visits are guided and framed by design professionals in the field, often policymakers or clients who provide the design brief and project constraints. This phase represents intensive information-gathering – taking lots of notes and pictures – that students will later sift through back in studio.

Figure 4a and b: GSD students on a studio trip to Rotterdam with renowned architect and visiting professor Rem Koolhaas. Source: GSD Studio Abroad.

3: Studio

The studio area takes up the majority of the square footage in Gund Hall, aptly corresponding to the amount of time students spend in this space. Design students are notorious for living "in-studio," spending up to 80 hours a week at their desks, working on drawings, models, and socializing with studio-mates. Most people spend their entire days and evenings here, leaving only for classes and sleep, especially during final review season.

Each student enrolled in a studio course receives a semi-private desk area, with a 30" x 70" table space. The open air studio is combined with frosted plexiglass dividers between studio desks, making for semi-private workspaces. Depending on where one sits in this five-floor studio, one may hear the din of conversation in the cafeteria downstairs, printers and plotters whirring at the ends of each floor, and people walking through on their way to classes. To indicate focus, students plug in headphones and listen to music, podcasts, or watch TV as they work.

Throughout the semester, students have multiple opportunities to showcase their work and receive feedback: peer feedback between students in studio; desk crits (one-on-one meetings with faculty at student desks); pin-up sessions where students pin up their work for faculty to critique.

Figure 5a: Gund Hall studio space without students. Source: World Architecture Map.

Figure 5b: Gund Hall studio space at peak occupation. Source: Hayoung Hwang.

4: Studio Review

The studio process culminates in a final review, where each student is allotted time to present his or her work to an esteemed panel, and receives feedback. At the end of each semester, Gund Hall transforms from museum to theatre mode as final review season dawns. Virtually all desk, floor, and classroom space becomes occupied by all kinds of materials and forms. The final review, or critique, is the telos of the design studio – where all efforts culminate in a single performance. The student carefully prepares drawings on boards, models on pedestals, and presents the project to a panel of design luminaries and studio-mates. The space is set up with the presenter's work as the focal point and the presenter defending the particular design proposal; surrounded by a panel of experts who ask pointed questions and examine the models and drawings at their leisure; and an outer halo of interested observers, mainly other students.

Figure 6a: A student presenting his work at a final review in Piper Auditorium at the GSD. Source: Serie Architects.
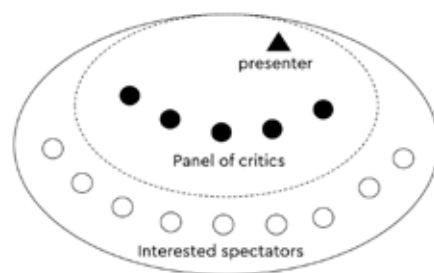
Figure 6b: A diagram depicting the spatial hierarchy of participants in a final review setting.

The findings from the second study revealed insights about the effectiveness of an open layout for productivity, in terms of both creativity (generating wild ideas) and focus (heads-down work time).

Figure 7: Plan view of the i-lab incubator space. Source: Harvard Innovation Lab.

The quantitative responses revealed that users were able to focus 70% of the time and felt creative about 41% of the time they spent in the incubator space. Some respondents chose to schedule certain types of work in the i-lab, such as meetings or team time, so within that time frame, productivity would have skewed high.

For those that spent all day in the incubator, early mornings and evenings tended to be the best times for productivity, as these times were quiet, with the least distractions. Mid-day brought peak noise hours, and almost all respondents dealt with noise by plugging in headphones or camping out in private meeting rooms. The open layout appears to work well for spontaneous meetings, socializing, and getting peer feedback. However, for the majority of making, or heads-down work time needed for entrepreneurial projects, the open layout often hindered productivity.

RESULTS

According to Amy Webb (2017), conflicts often arise in teams or organizations due to the "duality dilemma" – the clash between people whose dominant characteristic is either creativity or logic. Webb (2017) says this is responsible for a lack of forward thinking at many organizations An effective way that she proposes overcoming this duality is to "harness both strengths in equal measure by alternately broadening ("flaring") and narrowing ("focusing") its thinking" (Webb, 2017). The idea is to facilitate a co-working process whereby both generative, creative thinking as well as analytical, logical thinking are rewarded. With creative learning, a similar sequence of generative and logical modalities are needed.

One key pattern arising from the space use logic at both the GSD and the i-lab is the presence of both flaring and focusing as key activities of creative learning. Among these activities, the learner either focuses or flares on people or objects. As such, the following creative learning spiral was developed:

The spiral begins with *sparking,* or focusing on one person. These bouts of inspiration come from the setting of a lecture, talk, or a private meeting with some expert or mentor figure. Next, in the making phase, the learner focuses on objects with heads-down tinkering and work time. Third, the learner enters a research phase of *grazing* on different materials and objects, from precedent projects to research papers to field visits. Fourth, the learner socializes with his or her peers, giving and receiving feedback to discuss ideas and refine their projects. The spiral closes with a phase of *reverse sparking*, where the learner demonstrates his or her learning through performing or showcasing the project. At this phase, the
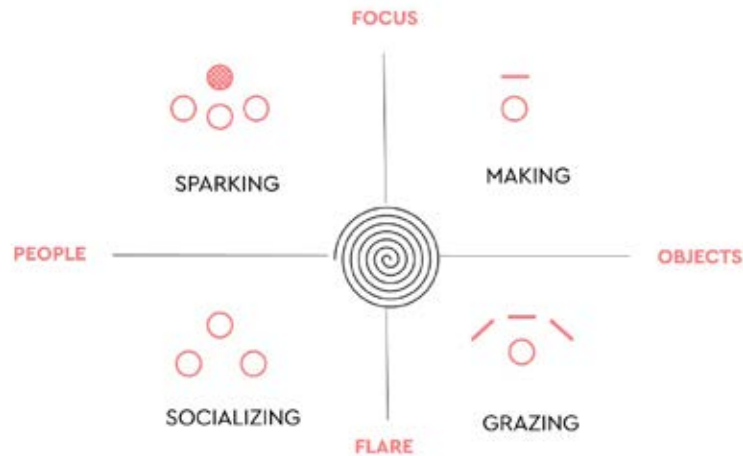
Figure 8. The creative learning spiral, depicting four modes of learning: sparking, making, grazing, and socializing.

learner receives critical feedback from mentors and experts, and the aim is for this feedback to funnel into future work. This process is not linear – learners can go back and forth between phases during the creative learning process. Moreover, creative learning is iterative – hence a continuous spiral.

This spiral can become a useful framework for both designing and assessing learning environments for creative work. For educators and institutions looking to move towards student-driven, hands-on project-based learning, these four learning modalities and postures can serve as a fruitful launch pad for learning space and curriculum design.

Key questions in designing a learning environment include:

- What does this type of learning look like (i.e. human postures and activities)?
- How might we effectively provide learners with access to the people, materials, and resources needed for this specific project?
- What pedagogical tools (including spaces) need to be considered?
- What measures of learning do you hope to enhance in this learning environment?

DISCUSSION

Much of the existing literature on creative learning focuses on the learner's personality, or interactions with educational material and other people. Often, the environment in which this learning takes place is overlooked, yet has a significant impact on the learning experience. This paper explored the potential for a creative learning framework defined through the space. Through participatory observation and user surveys, four activity types were identified as part of a creative learning spiral: s*parking, making, grazing, and socializing*. These four activity types were drawn from the different spaces that creative learning occur and are supported by.

Preliminary findings include some insights on how people use (or cope with) open layouts for productivity. In both cases of design studio work and entrepreneurial work, *sparking*, *grazing*, and *socializing* were all important aspects of the creative learning process. Gund Hall and the i-lab were both designed with these learning activities in mind, with ample space for interaction and connection among students, and between students and mentors. However, the majority of the time spent learning was in making or heads-down work time – where a learner works alone on a project or problem. At both the GSD and the i-lab, learners used headphones as an intermediary tool to achieve this kind of productivity.

For a design researcher, one key insight to draw is seeing headphones as a space "hack", or coping strategy, that learners use to make their open layouts work for them. In other words, there is a need for semi-private workspaces, particularly for acoustic privacy. There need not be a dichotomy between completely open layouts and enclosed cubicles or rooms – there exist many possibilities for semi-private booths, pods, and other design solutions to achieve the flexibility needed for creative learning.

One major contribution of this study was in coupling participatory observation (indirect input) with user interviews (direct input) to develop a learning theory centred on space use. Combining these modes were necessary in arriving at a more in-depth read on how learners utilize space. Further accuracy could be achieved by employing both methods in both spaces, and comparing the results. In addition, sensor technologies could be employed to complement or replace participatory observation, to reduce implicit biases and expand data collection capabilities to real-time, 24/7 inputs. Coupled with direct input from users, these insights have the potential to measure and enhance spaces for learning in a faster and more comprehensive way than ever before.

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A learning space embracing the development of the computational thinking skills of students

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ABSTRACT

Since the 1980s, industries have embraced digital technologies to increase efficiencies. Consequently, physical spaces have also been redesigned to nurture communication and collaboration, giving birth to a new set of competencies. Computational Thinking (CT) seems to be one of the essential competencies needed in the new industry and beyond. While its definition is still not clear, the school system seems to struggle to design a process favoring CT development, especially regarding the learning space. Our pilot study, conducted in two schools, introduced computer programming into their technology curriculum. This provided us with some initial insights about characteristics of learning environments that could enhance CT while pointing at new patterns of learning that also occur in the same environment. We are at the very beginning of trying to understand the complexity of the relationship between the learning space and the development of computational thinking skills of students, and deeper investigation of this relationship is needed.

Mario Chiasson is a leader in the application and use of Information and Communication Technology (ICT) in education. His role and responsibility at Anglophone East School District in Moncton, New-Brunswick, Canada include providing administrative and pedagogical vision for technological advancements in learning. Over the years, Mario has assisted schools, districts and ministries to understand the impact of ICT in the education system to engage students in their learning performances. In 2004, Mario completed a Masters Degree in ICT in schools administration and conducted two major research projects on mobile learning; "My e-Backpack" and "Bring Your Own Devices" (BYOD) at school. Mario is also a Microsoft Innovative Educator, a Cisco IT Essential Teacher, an Apple Teacher as well as an Apple Distinguished Educator (ADE). He has been a part of many provincial projects including a 1-to-1 laptop project, provincial and district collaborative platform (Portals), as well as international collaborative projects. Mario is currently enrolled in a PhD program at the Université de Moncton. His research focuses on learning spaces and the development of computational thinking skill

INTRODUCTION: CONTEXT AND PROBLEM STATEMENT

As the world continues to evolve to make society a better place to live, it had to embrace new technologies to increase productivity and efficiencies through creativity and innovations. The appearance of Information Communication Technologies (ICT) seemed to be the main reason why industries have transformed their operations and processes since the beginning of the "Digital Industry" in the 1980's (Lorenz, Rüßmann, Strack, Lasse, & Bolle, 2015). Consequently, new workspaces have been designed nurturing communication and collaboration (Kersh, Waite & Evans, 2012; Kersh, 2016). Also, new skills are now required such as creating, problem solving and critical thinking (Cobo, 2013; Miller, Soh, Chiriacescu, Ingraham, Shell & Paterson Hazley, 2014; Zhong, Wang, Chen, & Li, 2016). Amongst those skills, computational thinking (CT) started to play an important role in the past decade, as an efficient way to solve complex problems, so becoming a key competence and the most needed in today's workplace (Ambrosio, Almeid, Macedo & Franco, 2014; Barr & Stephenson, 2011; Bers, Flannery, Kazakoff & Sullivan, 2014; Brennan & Resnick, 2012; Wing 2011). Chiasson & Freiman (2017) mention that since the appearance of digital industry in the 1980's, the school system seems to be struggling to prepare students for this new world where 'old-fashioned' factual and procedural knowledge is not a priority anymore. What should schools do to better prepare students for the digital world?

In order to investigate this question, we need a better understanding of the latest developments of industry. What way has the ICT impacted this transformation? While reading, writing and arithmetic are still considered the foundation of basic skills, the learning environment needs to provide the opportunity for students to develop 21st century skills that industry requires, which includes, computational thinking (CT). Yet, it is still not clear what is CT skills, how it should be embedded in the learning culture, nor how it could be integrated in school curriculum. Also, the concept of the learning space needs to be revised, in connection to CT, as it could be an important factor of its development (Cobo, 2013). While focusing on characteristics of the learning space which would be beneficial for the development of CT in schoolchildren, our pilot research study reported in this paper attempted to capture learning patterns in students experience when introducing computer programming activities within a Broad-Based Technology Education Program in one of the school districts in New Brunswick, Canada. This study is a part of larger partnership network called Competi.ca whose main goal is to study digital competence development over the life-long continuum while focusing on (1) clarification of definitions and frameworks, (2) identifying best practices, and (3) initiation, in collaboration with partners from various sectors and disciplines, of innovative projects within a longitudinal perspective (Freiman et al., 2016).

COMPUTATIONAL THINKING: A SKILL NEEDED TO FIND SOLUTIONS TO PROBLEMS

As part of the 21st century skills set, Korucu, Gencturk & Gundogdu (2017) states that CT is increasingly essential tool to demonstrate through scientific research. Future generations are expected to engage in a better understanding of CT in order to work effectively with IT systems, technologies and methodologies (Korucu et al., 2017). All students today will continue to live a life strongly influenced by Information and Communication Technologies (ICT), and many will work in areas that will be influenced by computers (Barr & Stephenson, 2011). CT is a family of analytical thinking that uses mathematical and algorithmic thinking to understand and solve complex problems in the constraints of the real world (Wing, 2006). Much of the research has been devoted to problem solving over the last three decades. In fact, it is the human mind in the end that must be applied in a problematic situation and solve the problem. The ability to solve the problem is directly related to the knowledge stored in the mind (Brennan & Resnik, 2012). Knowledge is the product of thought and the nature of the problem dictates the level of thought. Higher order thinking can be conceptualized as a non-algorithmic and complex way of thinking that often generates multiple solutions. Such reflection involves uncertainty, the application of multiple criteria, reflection and self-regulation (Buckley, 2012). On the other hand, the thought of the lower order could be considered as one that requires a minimum cognitive effort and is algorithmic (Buckley, 2012).

First postulated by Seymour Papert in 1980s and 90s through the use of LOGO programming language and the development of cognitive abilities in solving a variety of computer-based problems, computational thinking (CT) emerged as core concept being popularized by Jeannette Wing (2006), who defines it as a set of attitudes and skills that are all

universally applicable, not just IT professionals should learn and master. According to Denning (2009), CT is a new term for computer science discipline. However, the author adds that CT is not just about programming, it is a complete way of thinking. Similarly, Buckley (2012) explains that computer programming uses all the components of CT and the knowledge gained from the experience of addressing both explicit and tacit programming challenges that can provide a framework not only for information technology, but for all areas of natural science and health to the social and human sciences. In addition, the author shares that programming should be seen as an exercise in the development of CT, rather than vice versa. So we have an important, essential and very real "skill" of the 21st century that is learned through experience, interaction and active practice. Thus, CT has become a skill in which it is important to educate new generations who become competent not only through tools, but also to think and create. So, we do not have to wait until the students are in college to present these concepts. It is important and necessary to start teaching CT skill early and present it in different approaches (Magana, Marepalli & Clark, 2011).

LEARNING SPACE – CHANGE THE SPACE, CHANGE THE BEHAVIOR!

According to Branigan-Pipe (2016), teaching and learning strategies have changed, yet school buildings, physical structures, classroom organization and design remain essentially the same. Lye & Koh (2014) consider learning space as one of the key components of the school system. Despite the constantly growing number of studies dealing with the learning space, until recently, there has not been much research explaining the nature of the relationship between space and learning (Cox, Herrick & Keating 2012; Zufferey & King, 2016). Therefore, the questions of whether the classrooms have changed since the appearance of ICT, like industries did and what would be the characteristics of learning spaces that will unleash the ability to develop CT need further investigation

If we reflect on the industry trends, we can identify characteristics of leaning spaces that the school system needs to consider moving forward. First, learning space is a place where every student can learn, everything is connected (physically and virtually), anytime or anyplace is a teaching/learning moment and the learning happens through doing (Cobo, 2013; Miller et al., 2014). Secondly, modern LS is one that has lots of natural lights, mobile chairs, tables, and is rich in digital technology. Finally, LS are 1- diverse spaces to provoke and support all learning behavior, 2- adaptable to plan for flexible spaces that allow for dynamic interchanges amongst activities, 3- multimodal to provide choices by ensuring a wide variety of learning settings and 4- engaging to fuel learners from inside out, spurring a proactive approach fostering ownership, accomplishment and empowerment (Cobo, 2013; Gruskin & Season, 2016; Zufferey & King, 2016).

Previously, Chiasson & Freiman (2017) have identified three educational forces that would enable the school system to close the gap with the industry. First, it is essential to create and to design learning spaces where students and teachers can be fully engaged in their learning and teaching is essential. Second, it is crucial to provide a learning experience that shifts the students from "What" he needs to learn to "How" he or she needs to learn. The third, through the rich learning experience, students need to develop CT competencies required by industries. In our study we investigate how these trends can be reflected in activities that involve computer programming.

PILOT RESEARCH STUDY: PRELIMINARY FINDINGS

In order to have a better perspective of the impact of learning space affecting the CT development, we conducted a pilot project in one school district in New Brunswick, Canada involving 60 Grade 6 students in two schools in the Middle School Technology Education (MSTE) program. The research goals were to: (1) observe and assess student's computational thinking processes in the context of problem solving using computer programing; and (2) identify the characteristics of learning spaces favoring the development of computational thinking skills. Through bi-weekly classroom observations and interviews with teachers and students over five months, several points emerged. While that we are still in the process of analyzing data, in this paper, we mainly focus on the first goal.

In our study, students of one school were using Scratch and the second, Swift Playground. During their programming task, even though students used different software, we have discovered similar observations in both environments. At the beginning of the process, while students were either constructing a game or solving coding lines, students had first to understand what was needed, then refer to their previous knowledge and recognize if they had ever seen this kind of problem and remember how they had managed to solve it. After entering the first lines of their codes, students had to show perseverance and determination in continuing attempts, through trial and error, to solve the problem and to improve their solution. They seemed to be engaged and motivated by the task even if they faced some challenges during this process. One student said: "I am so excited when I have to solve problems using Swift Playground (…) I just can't stop!".

This increasing level of engagement and motivation during the work on CT tasks was also identifiable in many other students. At the same time, we also found that even if the learning space was in many aspects still traditional, we saw some emerging elements characteristics of new types of learning spaces which are described in the literature as adaptable, multifunctional, engaging, and technology-rich. Mobile chairs and tables seemed to support students' desire to collaborate with each other using different resources and navigated through different areas of the learning space which helped them to use this space more effectively and productively. Another student quoted: "I love (Teacher's name) class because we are free to move anything…and have lots of technologies". Teachers clearly expressed the importance of a rich-technology environment where students can easily use and move resources (tables, chairs, etc.) around the class to collaborate with peers. They also shared the concerns that without flexible learning space, it would be very difficult in to use new learning strategies like Project Base Learning (PBL) and Inquiry Base Learning (Branigan-Pipe, 2016).

CONCLUSION – RESHAPING THE LEARNING CULTURE

The current state of our K-12 school system is very complex as it is constantly challenged by the speed of ICT innovations. In order to be aligned with the demands of our society and the needs of industries as well as workplaces, the school system needs to be agile, flexible and adaptable shaping the processes of the development of 21st century skills including CT. Several initiatives have been launched by education communities in New Brunswick, Canada to introduce CT in our schools. One of those initiatives is being conducted within MSTE curriculum in one of the provincial school districts. During the school year 2016-17, we conducted a pilot study in two middle schools using Scratch and Swift Playgrounds to teach programming in Grade 6. Based on classroom observations, interviews and questionnaire, we found that diversity, adaptable, technology-rich, multifunction and engaging we mentioned above seems to empower the students' capacity to explore a variety of tasks in a risk-free atmosphere which encourages tinkering, creating, debugging, collaborating and perseverance that will eventually contribute to the development of high order CT skills.

In conclusion, it is clear that the education system needs to have a complete face lift. With that being said, it raises some questions about how, when and where students can learn. Do we need bells? Do we need walls? Furthermore, do we really need subjects? What policies do we need to change? Will our education leaders have the courage, commitment and willingness to take the risk to create a paradigm shift in order to prepare students in the digital society?

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