DESIGN AFFORDANCES AND USER PERCEPTION:

Investigating the Relationship Between Space Design and Pedagogical Possibility in an Innovative Learning Environment

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ABSTRACT

This major research project explores how teachers and school leaders at Branksome Hall, an all-girls International Baccalaureate (IB) school in Toronto, Ontario, Canada perceive the affordances (potential uses) of a new Innovative Learning Environment (ILE) under construction. This study adopted a social constructivist approach. First, primary research involving virtual reality (VR) walkthroughs identified the spatial features participants perceived as supporting their current and future teaching practices. Following this research, a teacher workshop built upon these features, exploring how well they aligned with the stated aims of the building. Abductive thematic coding was applied to the data according to the themes presented in Frelin and Grannäs' (2022) TEALE model—two additional themes were also uncovered that fall outside of this framework. The findings aim to guide the transition to utilizing the iCAST effectively through the creation of spatial profiles for each space under study. Each profile provides a dynamic resource for teachers that can be used to empower an exploration of the impact of space on pedagogy and to inspire the development of innovative practices. Seven insights were developed based on the analysis of primary data and secondary research. These insights were used to guide the development of five key practice implications for Branksome Hall's next steps, which involve cross-team collaboration, revisiting the building's aims, engaging in futures workshops, and intentionally developing teachers' spatial literacy and professional learning. This project highlights the evolving nature of educational purpose and how educators' perceptions of space are influenced by their core educational philosophies. Interestingly, the affordances perceived outside of the TEALE model align more closely with the European concept of "Bildung" and a more participatory approach to 21st-century learning.

ACKNOWLEDGEMENTS & DEDICATION

With gratitude, I acknowledge the land, lakes, and rivers of Kanata and the Indigenous Peoples who have stewarded their health for millennia. This place has provided the setting for creative connection from which I've gained knowledge, inspiration, and a profound sense of well-being all my life. The building that is the subject of this report is being constructed on the traditional lands of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. As an educator who lives and works on these traditional lands (covered by Treaty 13), I commit to using educational spaces to acknowledge and teach diverse ways of knowing, doing, and being in relationship with the land and community—fulfilling Truth and Reconciliation Call to Action number 62.

For Vince
This wouldn't have been possible without your steadfast love and support every single day over the past three years.

For my colleagues at Branksome Hall
Your perception of possibility knows no bounds, thank you for your participation in this major research project.

For Ben & Evan
With love, and a promise to be at every hockey game next season.

For Mom
Even when you wonder what I've gotten myself into next, you trust that I will choose the right direction in life—and you throw your full support behind me with the pride of a lioness.

For Dad
Each step of this journey has allowed me to stay close to you, I miss you every day.

And

My sincere thanks to Dr. Natasha Koustova and Nadine Arseneault for your guidance, support and friendship—you were angels on my shoulder.

With appreciation for my SFI peers—you have been windows into other worlds. I have learned much from you about professional design practice, a well-placed em dash, and the utility of a whiteboard on wheels.

My infinite gratitude to Ranee Lee, for supporting me through this process with care, compassion and for always being sure I had eaten.

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GLOSSARY OF ACRONYMS

There are dozens if not hundreds of acronyms used daily in education circles, here is an overview of those used in this report.

iCAST - Innovation Centre and Studio Theatre

ILE - Innovative Learning Environment

IBO - International Baccalaureate Organization

IB - International Baccalaureate

MYP - Middle Years Programme (IBO)

DP - Diploma Programme (IBO)

ATL - Approaches to Learning (IBO)

CSL - Centre for Strategic Leadership (Branksome Hall)

CRC - Chandaria Research Centre (Branksome Hall)

SMS - Senior and Middle School

JS - Junior School

SFI - Strategic Foresight and Innovation (MDes program at OCAD University)

VR - Virtual Reality

UDL - Universal Design for Learning

DEI - Diversity, Equity and Inclusion

SEL - Social Emotional Learning

LSP – Learning Strategies Plan

1.0 INTRODUCTION

"The stories we tell literally make the world. If you want to change the world, you need to change your story." **– MICHAEL MARGOLIS**

1.1 PREFACE

As I write this major research project (MRP), I am staring out at a vast excavation site on the northeast corner of Mount Pleasant Road and Elm Avenue in Toronto, Ontario, Canada. I wonder if a hole has ever held the weight of so much anticipation and hope for transformation. The building that will emerge out of this void sometime in 2025 is, at its core, merely bricks and mortar, concrete and steel. Yet, it has been meticulously designed to invite innovative teaching and learning opportunities to afford the future of education. But what does that future look like? We can be certain it won't resemble the well-worn path of the present. So, the question arises: What story will guide our esteemed 120-year-old school into that future, with a mission statement celebrating that "Each day, we challenge and inspire girls to love learning and to shape a better world?" If we are to shape a better world, we need to transform not just our spaces but also our story about the purpose of education and the roles that teachers, students, and the community play.

1.2 CONTEXT

Branksome Hall is an all-girls', all-year (JK-12) International Baccalaureate (IB) school in downtown Toronto, Ontario, Canada. In line with a global trend among leading independent IB schools, Branksome Hall is actively shaping the future through its commitment to creating learning environments designed for innovative approaches to delivering the IB program.

The IB continuum begins with the Primary Years Program (Grades JK-6), dedicated to shaping young students into active, caring learners with respect for self and others. The program fosters skills in critical thinking, inquiry, and intercultural understanding. Progressing to the Middle Years Program (Grades 7-10), the programme emphasizes practical real-world connections, enhancing students" communication, self-management, and research abilities.

The Diploma Program (Grades 11-12) builds on this foundation, allowing students to customize their learning to their interests. It offers an advanced liberal arts education that strengthens students' critical

thinking skills, problem-solving, and cross-cultural awareness. In turn, it nurtures their character and self-confidence (International Baccalaureate Organization, 2005).

The skills and capabilities developed through an IB education align with what many in contemporary education circles characterize as “21st-century skills” (OECD, 2019; Fullan & Langworthy, 2013; Ontario Ministry of Education, 2020). The Junior School (JS) program currently supports these skills through a largely transdisciplinary approach to curriculum delivery, and the middle school is increasingly focusing on interdisciplinary inquiry-based learning. The program in all three schools (junior, middle, and senior) is further supported by strong connections to developing competencies in social and emotional learning (SEL) as well as diversity, equity, and inclusion (DEI).

1.3 PURPOSE

This major research project is inspired by a desire to address a pressing need of personal and practical significance. In the context of 21st century transformative drivers, including globalization, the development of knowledge-focused economies and technological advancements, education faces escalating demands to respond effectively (World Economic Forum, 2018). Consequently, there is a growing emphasis on understanding the optimal learning environments to support students in acquiring essential skills for thriving in an increasingly complex world.

In setting out on my MRP journey, my purpose was to continue to explore and apply a variety of tools and approaches learned in the SFI program: systems thinking, foresight, innovative design research methods, and design thinking. As a secondary school design teacher, building confidence with various approaches to studying the field of design was one of my reasons for enrolling in the program.

Secondly, I wanted to do something that could be useful. This work, a reconnaissance mission, is for my colleagues. My objective is to provide a starting point to guide the transition looming before all of us—to teach in the 21st century, in innovative spaces requiring innovative pedagogies under unprecedentedly rapid conditions of change. This transition is unlike any that we have gone through before, except for one thing—people are still the defining instruments of transformation in education.

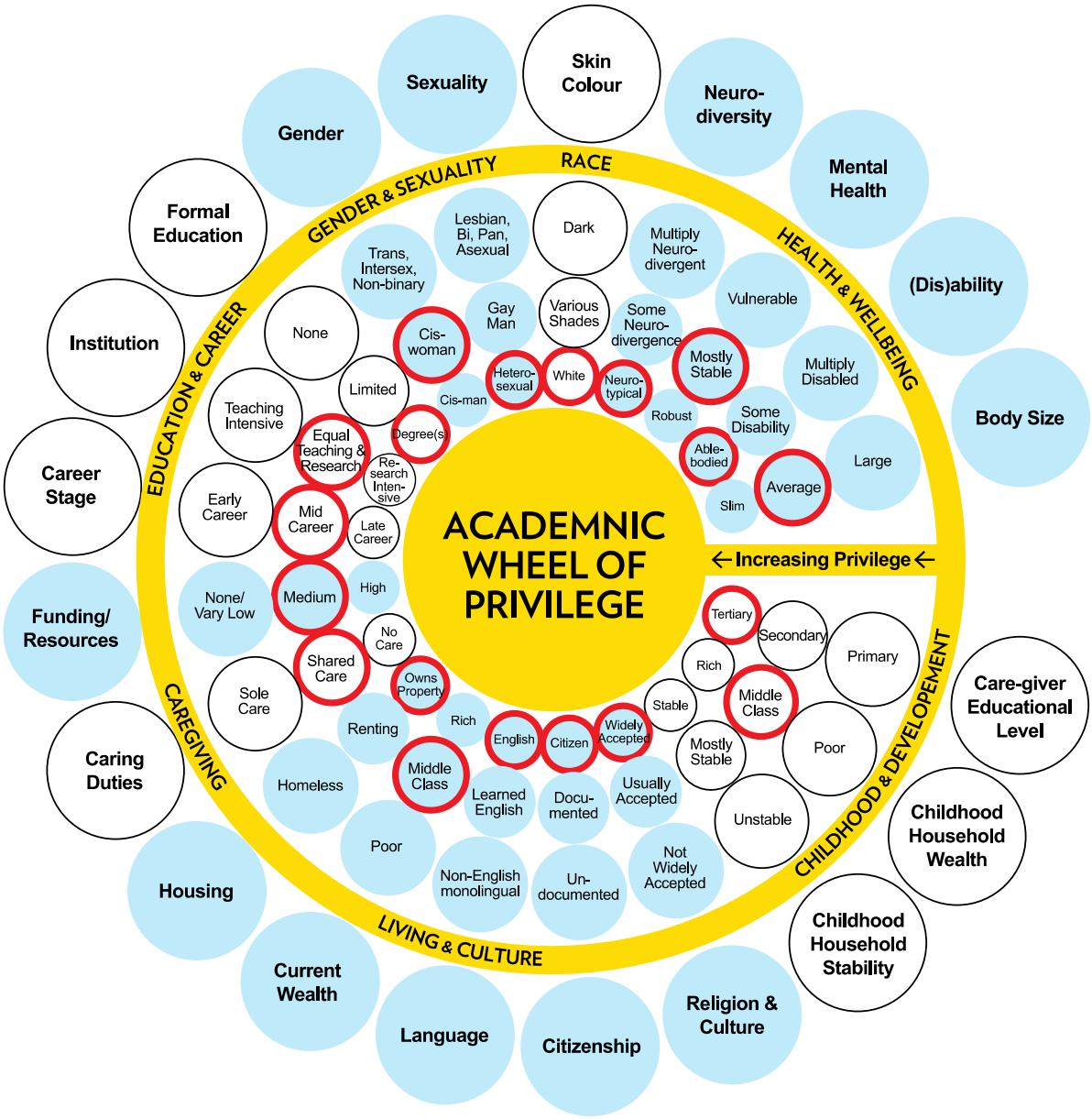
1.4 RESEARCHER POSITIONING

To position both the knowledge produced from this research and how it was produced, I found it helpful to reflect on how my values, chosen methods, and academic background could be seen to shape this research and the knowledge produced (Braun & Clark, 2022). Here, then, is a summary of my personal, functional, and disciplinary reflexivity.

PERSONAL REFLEXIVITY

Figure 1 is a visual representation of the intersection of my social positionings based on the UK Research Integrity Office's "Academic Wheel of Privilege" which highlights twenty identity types spanning seven categories. The identity types are shown as three concentric circles spiralling from outer to inner rings. The closer to the centre one identifies, the more privilege they benefit from.

Figure 1: Academic Wheel of Privilege



Note: Visual representation of the intersection of my social positionings based on the 'Academic Wheel of Privilege' (Elsherif, 2022 as cited in the UK Research Integrity Office, 2024).

It is evident from Figure 1 that I occupy a position of high social privilege, having grown up in a white, middle-class educated environment in Canada. Naturally, this level of privilege has influenced my experience of the world in that doors have always been open for me, and education is viewed as a worthy investment. I recognize that this position influences how others view me and my work—as a Western-centric figure given the institutions in which I have been raised and subscribed to all of my life. It is also, however, precisely because of the education I have had the privilege to seek out through less formal institutions and more human connections that I have become committed to pursuing pathways to expand my understanding of knowledge frameworks and constructions of space to include alternative knowledge traditions and constructs of space, place, and boundaries.

It is prudent to note that in the context of the topic under study, I am an inside researcher and a member of the group I am studying. As the Instructional Lead of Design at Branksome Hall, I have a vested interest in the outcome of this project. I have taught at Branksome Hall under the International Baccalaureate (IB) program for my entire career. The IB program was established in 1968 in Geneva, Switzerland and its mission is to develop "inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through education that builds intercultural understanding and respect" (International Baccalaureate, 2005). It is fair to say that I have strong relationships with many of the participants in this study given the length of time I have worked with many of them, and that trust and rapport have been established. It is also possible that the comfort level between myself and some of the participants could influence the data in my interpretation of it and what is shared and/or withheld.

FUNCTIONAL REFLEXIVITY

Acknowledging the potential impact of my subjectivity, I now turn to the influences of the research design itself. Design research methods were chosen as tools for collecting user-centred research data that would purposefully structure observations and conversations. The chosen methods were intended to leverage the strengths of immersive technology and discussion to ground insights in both experiential and practical realities. As part of my Strategic Foresight and Innovation (SFI) coursework, I developed an awareness of the relational nature of Indigenous epistemology and an understanding that in an Indigenous research paradigm, methodology and axiology must align with principles of relational accountability (Wilson, 2008). This approach resonated with me as an inside researcher, and while I have taken inspiration from the idea of relational accountability, which Wilson (2008) describes as requiring that "methodology needs to be based in a community context" to be relational and has to "demonstrate respect, reciprocity and responsibility to be accountable as it is put into action" (Wilson, 2008 p. 99). I do not contend that this work is focused within an Indigenous research paradigm. I simply wish to acknowledge its existence and the inspiration I took from it.

Walkthroughs conducted in virtual reality were selected as one method of gathering data; this methodology has its roots in the 1990s and is widely acknowledged as a usability inspection method (Martin & Hanington, 2012). To build on the data gathered during the walkthroughs, which were run individually, I conducted a workshop for teachers to consider the perceived affordances (action possibilities) concerning the aims and objectives of the iCAST. The group setting allowed participants to share perceptions, wants and needs, and dreams in a peer setting.

Finally, secondary research was undertaken both during the exploratory phase to lay the groundwork for design research and throughout the study to support the questions under investigation.

DISCIPLINARY REFLEXIVITY

I am a human geographer by training; human geography is a subfield of geography that focuses on how humans interact with and shape their environment. I am also a K-12 educator. As a result, this work reflects an interest in a socio-spatial approach to examining how the design of Branksome Hall's iCAST building stands to influence the evolution of pedagogical practices and shape social interactions. My research questions reflect a hallmark of my training as a geographer—an interdisciplinary approach and, thus, a commitment to understanding the complex interplay between spatial design, educational practice, and human experience in the context of innovative learning environments.

In my limited experience as an academic researcher, I have tended to favour a qualitative research approach to capture the truth of people's lives and experiences, and to examine the nature of reality. My undergraduate thesis focused on a journal analysis of elementary students' behaviours toward the environment after participating in an outdoor environmental education program.

Upon reflection, my life's trajectory, encompassing my experiences, guidance from teachers, and mentors, the values instilled in me by my family, and the Canadian social institutions of which I have been a part, have significantly influenced (and continue to influence) my ontology. In turn, a social constructivist research paradigm rather organically surfaced for me while doing this work and guided this research. The methodologies that I have chosen to explore in my research questions stress interaction and the development of relationships with my participants to collectively interpret and make sense of the spaces within the iCAST building. Ultimately, I agree with Wilson (2008, p. 37), who states: "Knowledge in itself is not seen as the ultimate goal (of research), rather the goal is the change that this knowledge may help to bring about." This idea holds particular importance for me as an inside researcher.

1.5 RESEARCH QUESTIONS

PRIMARY RESEARCH QUESTION

How might we leverage the perception of design affordances in line with the TEALE model among teachers and school leaders of a multi-zone innovative learning environment to support the activation of space as a pedagogic tool?

SECONDARY RESEARCH QUESTIONS

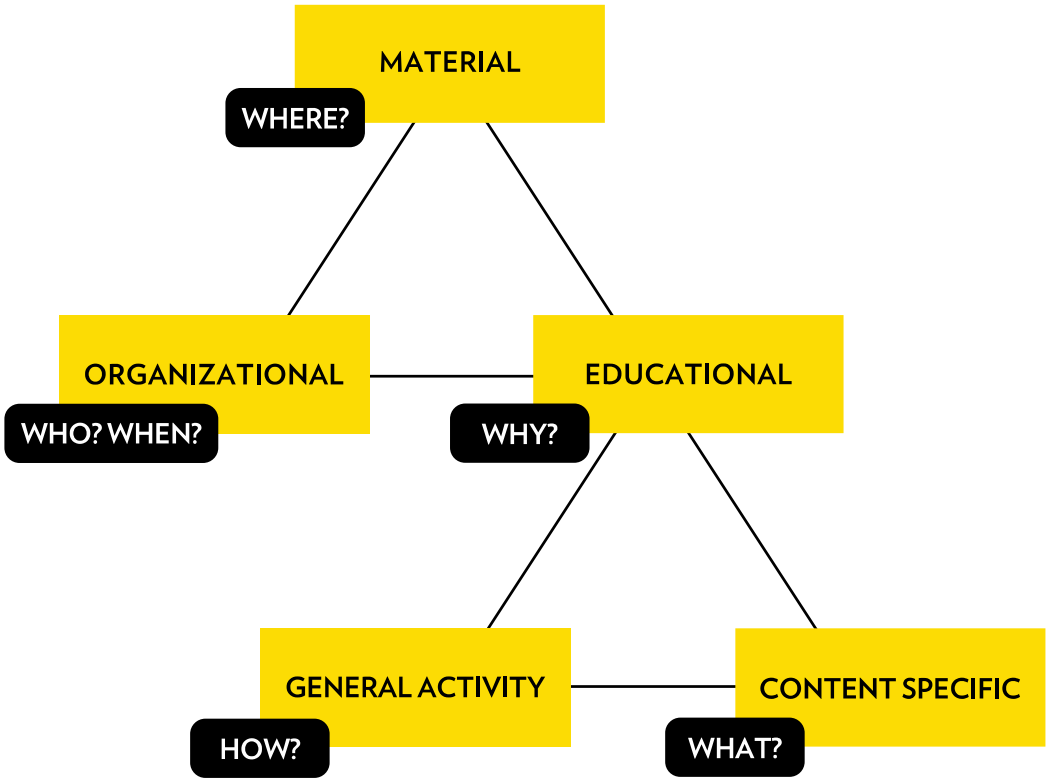
- What drivers influence the desire for Innovative Learning Environments (ILEs)?
- What are Innovative Learning Environments (ILEs)? What are Affordances in the context of ILEs?
- What is Branksome Hall trying to achieve through the building of the iCAST?
- What influences the way educators perceive learning environment affordances?
- How are the affordances within the study spaces examined perceived by leadership and teachers during the pre-occupancy phase?
- What affordances are perceived within the study spaces examined?
- What spatial qualities enable and/or constrain the principle aims of the iCAST?
- What are the next steps for the iCAST early transition phase that leverage the current perception of affordances?

2.0 RESEARCH METHODOLOGY

2.1 OVERVIEW

To better understand educators' perceptions of design affordances within Branksome Hall's Innovative Learning Environment (ILE), also known as the iCAST, I chose to use a social constructivist approach to the research process. Braun and Clarke (2022) describe the approach in this way: "Reflecting what we 'know' a particular thing is, doesn't reflect some true nature, but is a product of human practices, located in particular cultural and historical contexts." They go on to suggest that a constructivist thematic analysis "...is concerned with exploring what or how reality has been 'made' (constructed), and usually what the implications of this are" (p.183). The TEALE model (Frelin & Grannäs, 2022) Figure 2 offers a valuable framework, derived from empirical research, to understand the affordances enabled by the iCAST's design. As outlined below, the model can also help educators explore how these possibilities are communicated and adopted. This focus on recognizing affordances and prompting collegial discussion aligns well with the social constructivist paradigm, which emphasizes knowledge building and transfer through collaboration and active engagement, making it a suitable lens for examining this project.

Figure 2:Teacher Evaluation of Affordances in Learning Environments (TEALE) Model



Note: Frelin & Grannäs, 2022 empirically generated analytical TEALE model is a framework that supports educators to identify and adopt affordances of learning environments.

To answer my primary research question, I chose to frame my field research using Frelin & Grannäs' (2022) TEALE model for three reasons.

First, there is a limited understanding in the literature of how to best prepare teachers for the transformative process of adapting to ILEs (Grannäs & Stavem, 2021; Charteris & Smardon, 2017; French et al., 2020; Kariippanon et al., 2019). The TEALE model provides a framework that is in line with Branksome Hall's pre-occupation context as the model was empirically designed as an overview of pertinent affordances that guide educators' pre-occupancy evaluations. Its utility can be further applied to guiding educators' understanding and dialogue around using new kinds of learning environments. In this way, this project continues to build on the existing literature.

Second, the TEALE model offers a basis for qualitative research methods, which is well-established in school environments and environmental design research (Gigalson, 2010). In this particular study, it offered the best approach for my time constraints, specific context, practice, and experience.

Finally, as perceptions are inherently shaped by existing knowledge and experience, I begin by exploring a simple yet crucial question: "What do you see?" (Trafton, 2019)

The TEALE model (Frelin & Grannäs, 2022) offers a valuable tool to guide an exploration of educator perception. Its structure is built on curriculum theory-based questions of purpose and social meaning that typically guide educators planning considerations and decisions.

Employing this model allows me to investigate both:

- Perceived affordances: Which affordances (positive and negative) of the learning environment are currently recognized by educators?
- Latent affordances: What untapped potential exists within the space that could be leveraged for innovative pedagogies?

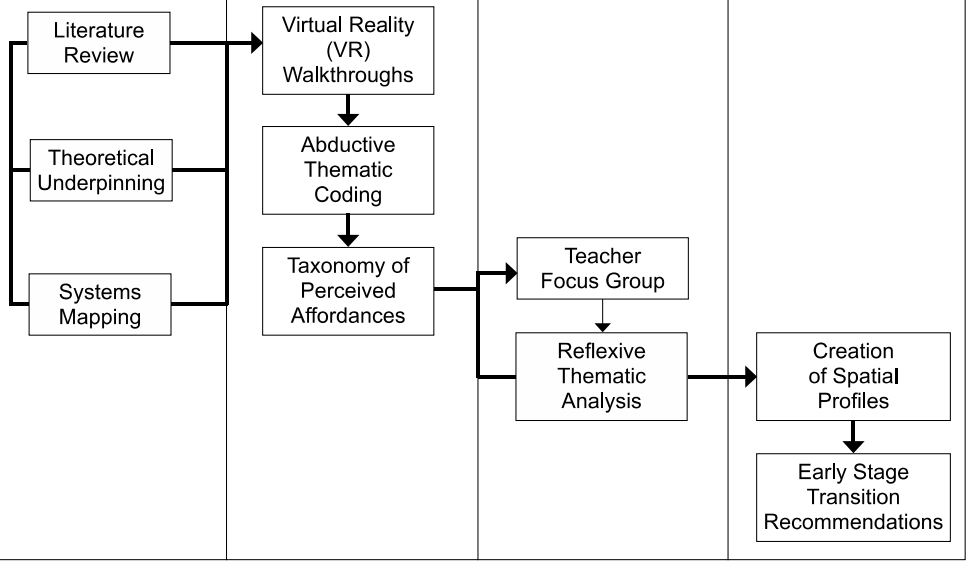
2.2 RESEARCH PROCESS & METHODS

A combination of design methods and systems tools were employed throughout the four phases of the project which are loosely based on the British Design Council's (2024) Framework for Innovation:

1. **Discover:** Demystifying ILEs
2. **Define:** Unveiling Potential
3. **Develop:** From Blueprint to Learning
4. **Design:** Turning Perception into Practice

Each phase addresses key secondary research questions that support the primary research question. A visual summary of the methodology is provided below, followed by a more comprehensive description of each individual research task.

Figure 3: Visual Overview of the Research Methodology

	DISCOVER	DEFINE	DEVELOP	DESIGN
	Demystifying ILEs: *Drivers, Goals and the Educator Lens*	***Unveiling Potential:*** *How Leadership and Teachers Perceive Affordances of Branksome Hall's iCAST in the pre-occupancy phase*	***From Blueprint to Learning:*** *Aligning Spatial Qualities with Branskome Hall's iCAST Vision*	***Turning Perception into Practice:*** *Recommendations for Activating the ILE as a Pedagogical Tool*
PRIMARY RESEARCH QUESTION	**How might we leverage the perception of design affordances in line with the TEALE model among teachers and school leaders of a multi zone innovative learning environment to support the activation of space as a pedagogic tool?**			
KEY QUESTIONS	*What drivers influence the desire for Innovative Learning Environments (ILEs)?* *What are Innovative Learning Environments (ILEs)?* *What are Afforrdances in the context of ILEs?* *What is Branksome Hall trying to achieve through the building of their ILE (iCAST)?* *What influences the way educators perceive learning environment affordances?*	*How are the affordances of Branksome Hall's iCAST perceived by leadership and teachers during the pre-occupancy phase?* *What aff ordances are perceived within the study spaces examined?*	*What spatial qualities enable and/or con-strain the principle aims of the iCAST*	*What are the next steps for the iCAST early transition phase that leverage the current perception of affordances?*
RESEARCH TASKS				

Note: This overview showcases project stages, research tasks, key questions, and the connections amongst each task.

DISCOVER

Literature Review

The literature review draws upon a robust selection of scholarly sources, including journal articles, books, internal school documents, and research briefs relevant to Branksome Hall's site master plan and strategic vision for the iCAST. I have taken a reflexive approach to the literature review, meaning my aim is not to identify gaps in existing literature. Instead, I seek to contribute to a richer tapestry of understanding, building upon the work of others in different places, spaces, and times (Braun & Clarke, 2022, p. 128). My review explores the historical and contemporary drivers behind the desire for ILEs. Specifically, I focus on Branksome Hall's aspirations for the iCAST and how the project aligns with the broader trends of educational transformation towards ILEs that support innovative teaching practices. Ultimately, the aim is to situate Branksome Hall within this larger context.

Theoretical Underpinning

The TEALE model (Frelin & Grannäs, 2022) was created to understand educators' pre-occupancy perceptions of affordances inherent in innovative learning environments. In developing this model, Frelin and Grannäs (2022) considered two relevant curriculum theory traditions: The Anglo-American tradition and the continental European tradition, captured by the German word "Didaktik. Both traditions have relevance to the school's educational program. These theories of knowledge provide insight into western educators' perceptions of what a learning environment "looks like" and sheds light on what spatial features they associate with action capabilities. Thus, I also explored affordance theory.

Systems Mapping

Systems mapping was employed at the outset of the project to gain a deeper understanding of the complex relationships and flows within innovative learning environments. The utility of systems mapping lies in its facilitation of a holistic understanding of the structure and dynamics of a system, as well as its ability to enable the potential for changes or improved outcomes (Jones & VanAel, 2022). In this way, it was applied as a visual sensemaking tool. Systems tools were used in this project to better understand the drivers of ILEs and the stakeholders relevant to the project.

DEFINE

Primary Research: Virtual Reality (VR) Walkthroughs

In November 2023 one-to-one virtual reality walkthroughs of the iCAST building were conducted with 27 participants, including eight school leaders, one educational consultant employed by the school to work on the iCAST project, one project architect, and 17 teachers from across the junior, middle, and senior schools at Branksome Hall. These participants were selected based on their level of relative power

within the system, ability to change the system, and level of knowledge about ILEs. The actors map in Appendix A shows these groups in the top right-hand corner as key project stakeholders.

I selected the VR walkthrough as a data collection method to leverage the idea of VR as an “empathy machine,” a phrase largely attributed to filmmaker Chris Milk (2015). This method allowed participants to experience the iCAST spaces as if they were physically present, offering a more realistic, human-centred evaluation of affordances compared to traditional 2D plans and models. Participants were recruited via email outreach, and a participant pre-screening form was distributed to gauge participant interest and experience level. Each virtual walkthrough was approximately 30 minutes long and was conducted in a fully immersive environment in which all information was decorrelated from the real-world environment. Participants were required to wear a head-mounted display unit, a Meta Oculus 2. It filled their field of vision with a 360° immersive experience of the iCAST building (See Figure 4).

Figure 4: VR Walkthrough Participant

This technology was made available to me through the school, which hired a third party to produce the VR experience for fundraising initiatives. Participants responded to a series of questions that were the same for each of the Pitch Space, Robotics/Design Space and the Noodle/Ideation Space:

1. How might this space enable learning activities with your students, currently or in the future? Please comment on specific features like staircases, retractable doors, surfaces, floor space, furniture etc.
2. How might this space constrain learning activities with your students, currently or in the future? Again, please comment on specific features.
3. Based on what you have just described, what approaches to teaching and learning do you feel are best supported within this space?

All participant responses were recorded and transcribed using Otter.ai, while their walkthroughs were screen recorded and correlated to their responses.

Abductive Thematic Coding

I used an abductive approach in my initial exploration of the data collected through VR walkthroughs as a complementary approach to reflexive thematic analysis—also used in this project. Data was coded according to themes presented by the TEALE model and emerging themes outside of this framework. In all, 82 codes were generated from 27 participant VR walkthrough transcripts. Using spreadsheet categorization for those codes that fit into the TEALE model, codes were grouped into three (pre-existing) themes. Affinity mapping was used for those codes that emerged outside of the model and resulted in an additional two themes. This mapping allowed for the element of surprise to be present in shaping the final analysis, ultimately expanding the application of the TEALE model in a context-specific way.

Spatial Profile of Perceived Affordances

As an output for this project, a spatial profile for each of the three spaces examined was created from the affordances identified by participants during the VR walkthrough. Similar to a taxonomy, Trum and Bax (1996) describe its utility as “an instrument for analysis of existing buildings or building designs, but it can also be used as a design-aid” (p. 4).

DEVELOP

Primary Research: Teacher Workshop

I wanted to build on the data gathered during the individually run VR walkthroughs. Therefore, I ran a teacher workshop on January 17, 2024 using perceived iCAST spatial qualities emergent from the VR walkthroughs to see if they enabled or constrained the aims of the iCAST building as laid out in the 2018 “Branksome Hall Innovation Centre: A Vision for the Future” document. Thirteen of the seventeen teacher participants were in attendance. After a brief introduction, participants were partnered up to make connections between iCAST aims, and the spatial features identified. Following group discussions and idea generation, each pair presented their findings to the larger group. Each group presentation was

audio recorded and transcribed using Otter.ai. The purpose of the teacher workshop was to allow for varied ideas, questions, and interpretations to be heard together in a peer setting as a sort of sensemaking exercise. When used with the data collected through the VR walkthroughs, this data allows for a more comprehensive understanding of teachers' perceptions of the use of space.

Reflexive Thematic Analysis

My choice of a reflexive thematic analysis approach stems from my positionality as an inside researcher in this work. I recognize that my own biases and subjectivity can influence the analysis, and Braun & Clarke's (2022) description of a reflexive researcher resonates deeply with me: "A thoughtful and (self) questioning individual who identifies and interrogates their positions, values, choices, and practices within the research process, and the influence of these on knowledge generated; someone seeking awareness and new possibilities" (p. 15). In addition, with a flexible, reflexive application of thematic analysis, it was possible to be informed by themes in existing research on the affordances of ILEs; which in this case was the Frelin & Grannäs' (2022) TEALE model.

DESIGN

Recommendations

From the insights gathered during the VR walkthroughs and the Teacher Workshop, I created a spatial profile, or taxonomy for each of the three iCAST spaces. The spatial profiles provide overviews of the perceived action possibilities. These overviews are intended to support teachers in viewing the space as a pedagogical tool. As Young et al. (2019) note, a taxonomy serves as a valuable tool for educators. By categorizing a space's enabling and constraining features, it empowers teachers to make informed decisions about pedagogies that best suit the needs of a 21st-century learning environment. Five early transition stage recommendations were designed to support teachers in activating the iCAST spaces in tandem with the affordance approach presented in the spatial profiles.

3.0 DISCOVER

3.1 LITERATURE REVIEW

AIMS OF THE ICAST

In 2016, the school identified a need to "transform and renew its East Campus to support the requirements and expectations of 21st Century education" (East Campus Renewal Study, 2018). As one project within a larger campus renewal project, the vision for an Innovation Centre and Studio Theatre, henceforth referred to as the iCAST, is deeply rooted in Branksome Hall's 2022-2025 strategy refresh. Its mission: "*To create unparalleled physical spaces in downtown Toronto that facilitate continual adaptation of learning in an exponentially changing world and workforce.*"

While the architectural blueprints for the iCAST offer promising innovative spaces for learning to align with the school's strategic goals, research indicates that these spaces are not always well understood by teachers (Kariippanon, 2019; Lackney, 2008; Young et al., 2020). The risk lies in the possibility that the intentions for the iCAST's learning spaces may not effectively translate into the desired future state principles or the aims of the iCAST as laid out in "Branksome Hall Innovation Centre, A Vision for the Future" (2018):

- Engaged and networked communities of practice
- Accessible learning activities that invite intentional play and risk-taking
- Interdisciplinary and transdisciplinary approaches to solving "grand" and "micro" challenges
- Flexible and inclusive learning spaces supported by innovative technologies
- Innovative and accessible measures of learning
- Societal and cultural images and environments that promote diversity and opportunity in STEAM

It is against this backdrop that my motivation to undertake this major research project was established.

A critical objective of this project is to empower teachers and school leaders to achieve these aims by exploring their perceived affordances (action possibilities) of the iCAST. As Young and Cleveland (2022) suggest, uncovering these affordances can provide a springboard for developing a shared spatial lexicon. This lexicon, in turn, would serve as a foundation for discussion and collaboratively envisioning creative and engaging learning experiences that align with the iCAST's stated aims.

WHAT ARE ILES?

The idea of reconceptualizing physical environments—where learning takes place to better meet the needs of new generations of learners—has evolved over time and across geographies. The ideal of "open plan" schooling was initially conceived in the United States, England, and Sweden. Likewise, many open plan schools and variations thereof were constructed in Nordic countries, Australia, and New Zealand throughout the 1960s and 1970s (Hutchinson, 2004 as cited in Saltmarsh et al, 2015; Grannäs & Stavem, 2021). The purpose at the time was aligned with the progressive education movement and the ideas of American philosopher and educational reform pioneer, John Dewey. From the early twentieth century, Dewey argued for a more student-centred model of learning. He highlighted the importance of social context, student interaction, and play (Dewey, 1966 as cited in Dovey & Fisher, 2014). Space was seen as essential for good pedagogy to support student-centred, individualized learning, various student groupings, and team teaching (Grannäs & Stavem, 2021). By the 1980s, questions about the functionality of open-plan spaces to support desired teaching practices came under examination, leading many schools to return to traditional layouts (Dovey & Fisher, 2014; Grannäs & Stavem, 2021; Horn & Kearns, 2018). On one level, the noise and the distractions became an obstacle for teachers, and on another, societal and cultural factors surrounding economic stagnation and the need for a "back to basics" approach set in (Drummond, 2017).

By the new millennium, a focus on developing "21st-century skills" gained momentum—shifting creative emphasis toward what we contemporarily conceive of as innovative learning environments (Darling-Hammond, 2008 as cited in Blackmore et al., 2011). These environments fostered new relationships between learners, families, communities, and teachers. Yet, they were built upon many of the core ideas that originally inspired the open-plan approach (Grannäs & Stavem, 2021). The re-emergence of student-centred pedagogy and a proliferation of communications technologies in schools that are difficult to optimize in traditional classrooms have fuelled architectural innovation to support the goals of ILEs as characterized by Mahat et al. (2018) below. Investment in new school design projects is often seen in the literature to be in line with changes to national curriculums as demonstrated in Australia (Blackmore et al., 2011), New Zealand (Carvalho & Yeoman, 2018), and Finland (Niemi, 2021).

While various definitions of ILEs exist in the literature, most notable for the context of this study and therefore referenced throughout, is the definition developed by the Innovative Learning Environments and Teacher Change (ILETC) project. The ILETC project is an Australian Research Council Linkage Project launched in 2016 that convened leading researchers in educational learning environments with partner organizations specializing in learning environment design and technology. It is affiliated with the Learning Environments and Applied Research Network (LEaRN) (ILETC, n.d.). This project holds that ILEs are "the product of innovative design of space and innovative teaching and learning practices. Innovative learning

spaces are physical educational facilities designed and built to facilitate the widest array of flexibility in teaching, learning, and social educational activity while innovative teaching and learning practices are the sum of teaching and learning activities that in combination assist in the best possible learning outcomes" (Mahat et al., 2018, p.20). "Only when these two phenomena are successfully merged do we produce an innovative learning environment" (Mahat et al., 2018, p.10). In a survey of the literature, the ILETC project characterized the key features of ILEs to enable (Mahat et al., 2018):

- Student-centred learning
- Spatial flexibility
- Malleable pedagogic practice
- Personalized learning
- Collaborative work
- Development of real-world skills
- Future readiness
- Creativity
- The potential to be enterprising

DRIVERS OF ILES

I employed a two-pronged approach to understand the motivations behind the desire for ILEs. First, I utilized environmental scanning, a foresight method, to identify macro-system drivers of change impacting the development of ILEs in a western context. This method uncovers broad trends and disruptions across industries that influence education. Additionally, I applied a systems tool—the iterative inquiry, to delve deeper into the more localized marketplace demands specific to Branksome Hall's context. Combining these approaches gives us a comprehensive picture of the factors at various system levels that contribute to the growing interest in ILEs, specifically the iCAST project.

The environmental scan delves into macro-system drivers—powerful forces shaping our world that can cause significant disruption across industries, regions, and sectors. (Ipsos, 2023; Bughin & Woetzel, 2019). Education has been no exception, with a current scan revealing various degrees of disruption from global drivers such as technological advancement, the fourth industrial revolution, climate change, and youth mental health and wellbeing. Table 1 provides an overview of four drivers of change alongside the characteristics of ILEs that can facilitate and encourage the adoption of new educational approaches in response to these challenges. These drivers, grounded in trends from the present have led to growing calls in education for learning environments that reflect more than simply a space where knowledge is transmitted, but rather, a dynamic ecosystem that prepares students for various possible futures (OECD, 2018).

Table 1: Drivers of Change Influencing the Desire for ILEs

DRIVER	DESCRIPTION	ILE CONNECTION
TECH-TONIC SHIFTS	The accelerated technological transformation of our societies, characterized by ongoing advances in biotechnologies, neuroscience and artificial intelligence, is reshaping the ways we live, learn, and interact within the school environment (UNESCO, 2021). In the most resourced contexts, there are risks and benefits of living in a technologically embedded educational environment—technology and digital media are increasing access, connection, and content, but not necessarily learning (IDEO, 2020).	The Canadian economy is transitioning from a "jobs economy" to a "skills economy," where digital fluency and "who you are" rather than "what you know" will be essential for success (Royal Bank of Canada, 2018). ILEs are purpose-built technology-rich environments that incorporate various tools and resources as well as student-centred inquiry approaches to learning that support the development of the "21st century skills" necessary to navigate future complexity.
WORK IN FLUX	The world of work is in the midst of a major transformation, comparable to the mechanization revolution that reshaped agriculture and manufacturing (McKinsey, 2024). Fuelled by advancements like artificial intelligence, automation, and robotics, the job market saw accelerated shifts after the COVID-19 pandemic, and the transformation shows no signs of slowing down (Semuels, 2020). While new opportunities will emerge, a crucial challenge arises. Many existing jobs will be impacted, and the skills currently valued may not translate to these new positions (ILO, 2019).	ILEs encourage an environment of inquiry and experimentation, not just as a result of the flexible spaces and resources they provide, but because of the innovative teaching and learning practices that go on within them. Educators who model adaptability, lifelong learning, and critical thinking by integrating transformative technologies and innovative approaches into their curriculum delivery are essential to supporting students' connection to and understanding of the ever-evolving nature of work.
PLANETARY CROSSROADS	We face a planetary crisis of unparalleled magnitude, characterized by the interlinked challenges of climate change, pollution, and biodiversity loss (UNFCC, 2022). According to UNESCO's 2021 "Reimagining Futures Report," the decades leading to 2050 will be pivotal for the future of humans and all other life on Earth—the choices made today will determine what futures are possible to 2050 and beyond.	Education plays a pivotal role in supporting objectives for adaption, mitigation, and planetary rebalancing. Yet, current environmental education does not cultivate the full breadth of competencies necessary to engage students beyond scientific teaching and on to the necessary development of civic engagement (UNESCO, 2021). ILEs can act as a community-based engagement platform, enabling multi-stakeholder

		partnerships to hone climate advocacy and civic leadership capacities (Global Partnership for Education, 2023).
REDEFINING SUCCESS	Outdated success measures and the tendency to see individuals as assets for optimization are worsening chronic health issues in youth (Prince et al., 2018). The stress of high-stakes testing, competitive university admissions, and increasing student debt are raising questions about the value of educational credentials, especially when they don't assure employment (Tereda, 2022; Prince et al., 2018). These pressures related to rising costs and job insecurity are notably affecting the mental well-being of today's teens and young adults (World Economic Forum, 2024).	Critical features of ILEs are to enhance personalized student-centred learning, provide flexible physical space and malleable pedagogies that focus on developing skills, and foster future readiness and the potential to be enterprising. These qualities are not designed as a precursor to the narrow, stress-inducing proxies for knowledge demonstration with which we are currently familiar. ILEs provide opportunities to re-think what evaluation looks like within a broader, more humane definition of growth that supports what the Royal Bank characterizes as a possible future where "companies hire for skills over credentials and it doesn't matter what you've done, it matters what you can do" (Royal Bank, 2018; Stolzoff, 2020; Mahat et al., 2018).

As previously noted, the iterative inquiry is a systems design tool based on Jamshid Gharajedaghi's systems inquiry. However, I have used the adaptation by Jones and VanAel (2022) developed to map out the structures, processes, and functions of an existing system as a project boundary framing exercise (see Appendix A). In this case, my purpose is to define system component levels that have influenced the shift from traditional education spaces to ILEs in Branksome Hall's context. It reveals the drivers within the current system and parallels Bronfenbrenner's Ecological Systems Model, used by Kariippanon (2019) to identify factors of influence on educational change. By viewing the system in this way, it is possible to see the connection between the macrosystem drivers outlined in the environmental scan above and the specifically contextualized exosystem and mesosystem drivers for Branksome Hall.
The overall picture is what Kariippanon (2019) refers to as a "complex adaptive system" driven by global trends toward meeting 21st-century student needs, workforce demands, and locally driven marketplace place demands. The convergence of these realities is what has collectively contributed to momentum in transforming the iCAST building educational space at Branksome Hall.

WHAT ARE AFFORDANCES?

The term affordance was originally coined by American ecological psychologist J.J. Gibson in 1979 and begins from a simple premise: how we perceive our world and the objects in it is not primarily based on their properties or qualities, but on what they afford us, or what they allow us to do (Gibson, 1979). Gibson used the term to mean "something that refers to both the environment and the animal… The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" (Gibson, 1979, p.127). Thus, affordances can be both positive (beneficial) and negative (detrimental). As Harwood and Hafezieh (2017, p. 3) note, "An affordance is not a property or quality residing in either the object or subject but relates to how objects are perceived with regard to their possibilities for use." It should be noted here that the literature uses the terms "properties," "qualities," and "features" interchangeably in reference to characterizations of space and spatial artifacts. For the purposes of this study, I will use the term "spatial feature" going forward. In Gibson's view, an affordance is the combination of a spatial feature plus its perceived action capability.

AFFORDANCES IN LEARNING ENVIRONMENTS

While the term "affordance theory" was coined in the late 1970s by Gibson (1979), the core ideas behind it were present earlier in the work of prominent school designers like Hertzberger (1969) and Medd (1970). Notably, Hertzberger's (1969) analysis of the Delft Montessori Primary School demonstrates the relationship between architecture and the way it interacts with people. Hertzberger argued that good architecture fosters optimal experiences for both people and things, prompting a search for the "right conditioning" for each element within the space (Hertzberger, 1969, p. 64). He emphasizes "listening well" to the needs of people and objects, suggesting that form should naturally emerge from this understanding rather than being imposed solely for aesthetic purposes (Hertzberger, 1969, p. 64). Building on this sentiment, Medd (1970) argues that the language used to describe schools often restricts educators' ability to perceive new action possibilities within school spaces. He calls for a "new approach to vocabulary" to reflect evolving educational practices (Medd, 1970, p. 178). This approach aligns with the concept of affordances as defined by Young et al. (2020), further supporting the idea of developing an affordance lexicon to analyze how environments actively support the creation of pedagogical approaches.

Young and Cleveland (2022) highlight the currently under-explored potential of affordances in aligning school design with evolving pedagogical needs. It is their assertion that understanding the action possibilities in a learning environment can guide discussions on creating spaces that actively promote effective teaching and learning, especially as expectations for what successful teaching and learning look like continue to evolve.

Although the iCAST spaces are still under construction at the time of writing, Young and Cleveland's (2022) perspective aligns with the fifth stage (activation) of Bojër's (2021) design framework. During

this stage, affordance theory can be a valuable tool for evaluating and potentially refining the already conceived spaces to ensure they effectively support the development of innovative pedagogical approaches.

3.2 THEORETICAL UNDERPINNING

AFFORDANCE THEORY

Since its inception, affordance theory has been applied and interpreted across multiple disciplinary fields. These fields include psychology, technology/human-computer interaction design, and anthropology (Young, 2020). It has been applied to a lesser extent in architecture and the built environment, including within school design (Atmodiwirjo, 2014; Maier et al., 2009; Young, 2020). Maier et al. (2009) posit that this weaker connection might stem from the historical distinction between form and function in architecture, an idea that dates back to influential Roman architect, Vitruvius, who argued that form, function, and beauty are separate, albeit competing aspects of architectural design.

The concept of affordances is relatively new in the field of learning environments, and as such, there are varying definitions for the concept. Throughout this project, I have used a definition developed by Cleveland, Imms, and Young (2020, p. 5) specifically for the learning environment context. In this context, affordances encompass “qualities of the environment (space, objects and people) which may be perceived to enable teaching and learning activities and behaviours.”

KEY CONCEPTS OF AFFORDANCE THEORY

Action Possibilities / Purpose

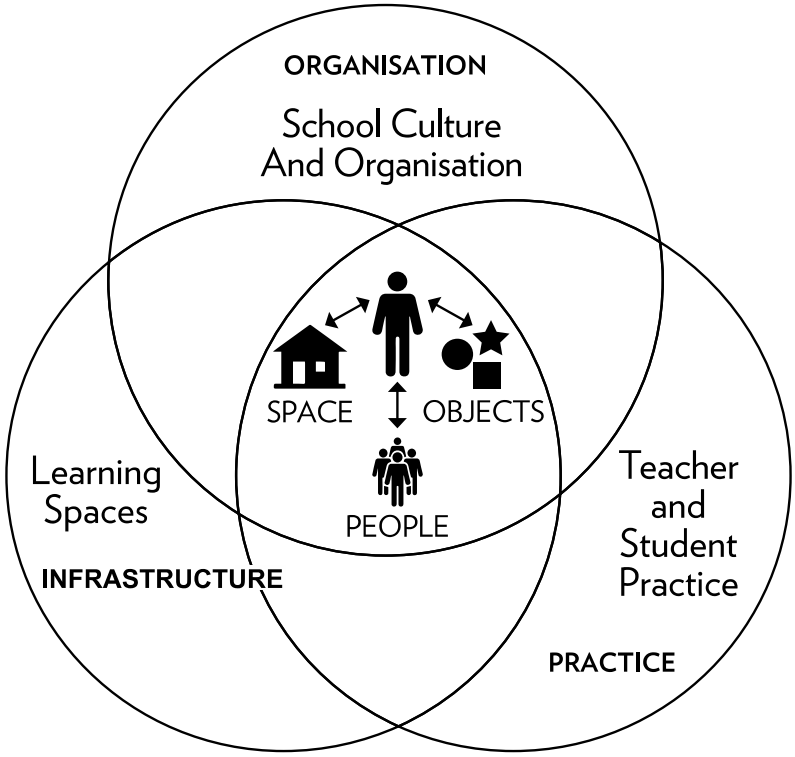
To illustrate examples of Gibson’s central concept of affordance theory—the relationship between the environment and the user and the potential action possibilities that arise from this relationship, we can first turn to an accessible example from the field of industrial design. Consider the handle on a mug. The shape and placement of the handle afford (or suggest) the action of grasping, indicating to the user how to hold the mug comfortably and safely to drink without touching the potentially hot surface. This intuitive design feature communicates its function through its physical characteristics, making its use apparent without needing instructions. In the context of learning environments, Frelin and Grannäs (2022) connect the condition of purpose to action, suggesting that affordances invite meaning and action, which may be educative (positive) or non-educative (negative). Gibson argues that because affordances arise from the individual’s point of view, they are thus value-laden (Gibson, 1979). For example, chairs on casters in a learning environment may be perceived to offer greater flexibility for students to move around the classroom, facilitating collaboration and engagement in various learning activities, which has an educative value from the perspective of an educator. However, a chair on casters can also be used as a toy for playful behaviour, which may have value from the perspective of the student but has no educational

purpose. In this example, we consider the individual context. Yet, in reality, as Ingold (2008) and Carvalho and Yeoman (2018) note, people and things are entangled in social life—the chair on casters might be used to engage playfully with friends. Thus, an understanding of affordances necessitates the consideration of the socio-cultural context.

Socio-Cultural Context / Social Meaning

Several researchers have examined the influence of sociocultural contexts which influence an individual's understanding of affordances. Gaver (1996) explores an ecological approach to social interaction using the idea of affordances to describe material properties of the environment that influence how people interact. Likewise, Lindberg and Lyytinen (2013) introduce the idea of affordance ecologies, indicating that affordances can encompass three distinct domains: infrastructure, organization, and practice. While Lindberg and Lyytinen's ecologies framework is rooted in a technology design perspective, Young and Cleveland (2022) adapted the framework in Figure 4 to the context of learning environments, showing the interrelations between school organization and culture, learning spaces and teacher/student practice. The addition of school culture and organization to what has typically been a dialogue about the relationship between infrastructure and practice demonstrates a recognition of the importance of school culture and the social life of a school when considering affordances within a school context (Young & Cleveland, 2022).

Figure 5: Learning Environment Affordance Ecology



Note: Affordance ecologies illustrate the interrelations between school organization and culture, learning spaces, and teacher/student practice. Adapted from Linberg and Lyytinen (2013) and by Young and Cleveland (2022).

Frelin and Grannäs (2022) propose that the affordances within an environment stem not only from its physical characteristics but also from the social meaning and established norms that govern its use. Consequently, the expectations and perceptions of teachers and students regarding the nature of a lesson, its content, instructional strategies, and location, are all shaped by the socio-cultural influence on their understanding of affordances.

Undoubtedly, schools are complex environments characterized by a multitude of human interactions and deeply ingrained norms. This theory resonates with the work of cognitive psychologist and human-computer interaction (HCI) designer Don Norman (1999), who highlights how shared beliefs and practices within a culture can constrain how people perceive affordances within a space. As Norman states, “A convention is a cultural constraint, one that has evolved over time. These conventions aren’t arbitrary; they develop within communities and are resistant to change. They are slow to adopt and even slower to disappear” (p. 4).

Perception / Fittingness

Perception is critical to the concept of affordances. Gibson (1979) suggests that the perception of an affordance is necessary for an action to occur. However, the affordance itself exists inherently, regardless of whether or not it is used, and may lie latent until actualized by an individual. He states:

> The affordance of something does not change as the need of the observer changes. The observer may or may not perceive or attend to the affordance, according to his needs, but the affordance, being invariant, is always there to be perceived. An affordance is not bestowed upon an object by a need of an observer and his act of perceiving it. The object offers what it does because it is the object it is (p. 138).

In contrast, Norman initially implied in “The Psychology of Everyday Things” (1988) that an affordance needs to be perceived to exist—it necessarily involves cognition, visibility, and discovery. This implication was a divergence from Gibson’s assertion of direct perception. However, Norman’s (2004) view was later revised to encompass the concept of “perceived affordances.” This view reflects the priority designers place on user perception over objective reality. As Norman stated: “In design, we care much more about what the user perceives than what is actually true” (p. 1).

Advancing a more holistic idea of perception, Ingold (2008) posited that affordances should be considered within an “entanglement” of factors. Frelin and Grannäs (2022) connect the concept of entanglement to the notion of “fittingness.” This perspective emphasizes analyzing the learning environment through the lens of entanglement between humans and objects. For example, the notion of fittingness may involve the consideration of the organization of time and space. Carvalho and Yeoman (2018) see fittingness as something beyond a spatial feature or affordance:

> The centrality of time, and the effects of order and sequence, are acknowledged in human-thing entanglements. Combinations of circumstances give rise to conjunctural events, which create problems that require fixing, and solutions are selected from what is to hand that is contextually appropriate, resulting in an alteration to the entanglement of the whole (p.29).

The organization of time and space is central to educators' decision-making around curriculum delivery in many daily situations. Frelin and Grannäs (2022) provide this example: The re-configuration of chairs and tables in a classroom may enhance the educational value of a particular task, but doing so may not be perceived as worthwhile if the remaining class time is too short. What may have been perceived as an affordance at the beginning of a class, may no longer be one towards the end (p.248).

CURRICULUM THEORY

Two basic models of curriculum theory predominate, internationally giving rise to contrasting approaches to educational theory: the Anglo-American tradition of curriculum and the Continental European tradition of Didaktik (Gundem & Hopmann, 2002). The Anglo-American perspective was developed from established social science theories from fields like sociology, psychology, philosophy, and history—where these theories provide the foundation for educational research and practice (Biesta, 2011). In contrast, the Continental European view elevates education itself to the status of a distinct discipline. This discipline delves into questions of human development, encompassing intellectual growth, fostering care and nurturing, and cultivating moral and social well-being within individuals (Biesta, 2011).

What is Curriculum Theory?

The idea of curriculum emerged in the United States in the early 1900s; decisions around what knowledge is of most importance, what should be taught and to whom, under what conditions, for what purpose and with what end in mind are all questions to be answered by the building of curriculum. As Null (2011) puts it more concretely: “What should be taught to these students, in this school, at this time, how, and to what end?” (p. 5). In addition, questions posed by Schiro (2012), as noted by Yaşar (2021) contribute to the scope of consideration: Are students passive or active subjects in their learning? Are teachers transmitters or facilitators of knowledge? What is the goal of evaluation?

The complexity of defining “curriculum” stems from its evolving nature, shaped by societal demands that differ across geographies due to various social, technological, economic, environmental, political, and cultural factors. This complexity extends to curriculum theories, which seek to provide a structured framework for curriculum development. The significance of curriculum theory was highlighted during the 1947 Conference on Curriculum Theory in Chicago, emphasizing that effective curriculum development requires a solid theoretical foundation (Yaşar, 2021). Though there is a sense in the literature that curriculum theory is one of the least understood concepts in the curricular arena (Macdonald, 1971;

McCutcheon, 1982; Cheung & Wong, 2002), researchers such as Glatthorn (2018), Beauchamp (1982), and McCutcheon (1982) have taken a loose or open view of the concept which seems particularly useful in the education context. Glatthorn (2018) defines curriculum theory broadly as "a set of related educational concepts that affords a systematic and illuminating perspective of curricular phenomena" (p.74).

In the Anglo-American tradition, there are four main approaches to curriculum theory. It should be noted that the terms theory, ideology, and philosophy of curriculum are used interchangeably in the literature, as are the classifications of curriculum theories themselves. Table 2 illustrates this point.

Table 2: Four Curriculum Ideologies in the Anglo-American Tradition

CURRICULUM IDEOLOGY	**SCHOLAR ACADEMIC IDEOLOGY**	**SOCIAL EFFICIENCY IDEOLOGY**	**LEARNER-CENTERED IDEOLOGY**	**SOCIAL RECONSTRUC-TIONIST IDEOLOGY**
ASSOCIATED IDEOLOGIES	Academic Rationalism Academic Disciplines Intellectual Traditionalists Humanist Knowledge-Centred Liberal	Technological Behavioural Social Behaviourist Managerial Systematic	Progressive Education Open Education Child-Centred Education Experiential Constructivism	Critical Reconstruction Social Meliorism Society-Centred Radical
PURPOSE OF EDUCATION	To help children learn the basis of our culture through the academic disciplines. It involves a deep understanding of ways of thinking that are taught by teachers who are mini scholars in their discipline.	To prepare young people with the skills they need to be successful in work and life and contribute to a thriving society. Instruction is guided by mastery of skills, and standardized testing.	The holistic development of individuals, honouring their unique blend of intellectual, social, emotional, and physical strengths. Educators support student agency and capability for growth.	Education has the power to restructure a new and more just society. Educators believe students can be raised to understand problems, offer solutions, and approach community problems critically.

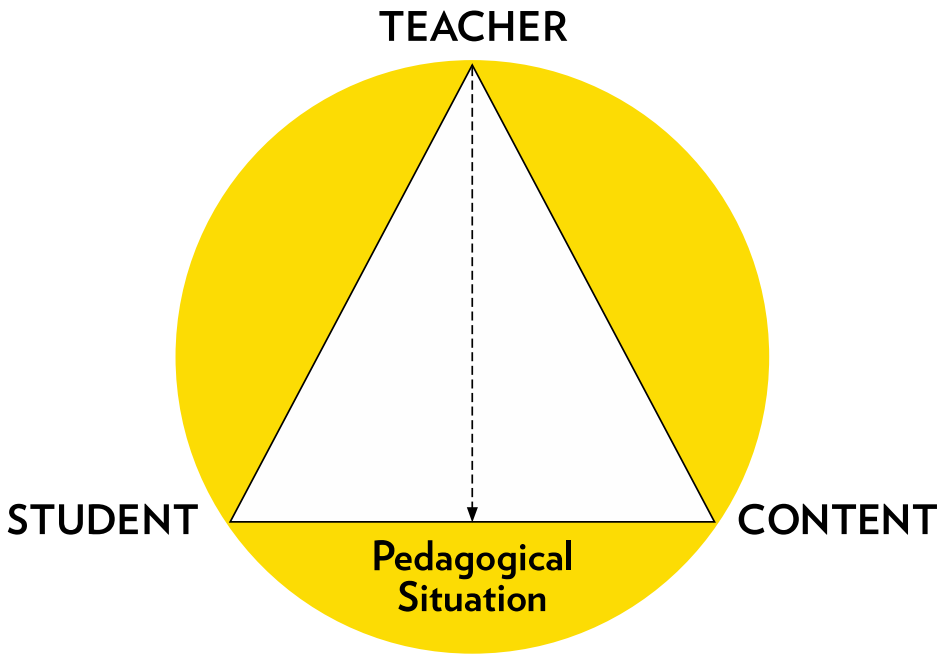
Note: Adapted from Schiro, 2012 and Yaşar, 2021.

What is Didaktik Theory?

To clarify for a North American audience, the meaning of the term Didaktik in German and Scandinavian languages differs from how the word “didactics” is used in English. In English, a didactic teaching method is taken to be a structured, teacher-directed approach to instruction. It focuses on the systematic delivery of content across various disciplines, often through lectures and presentations, with an emphasis on achieving specific learning objectives. The term “didaktik” in German and Scandinavian languages encompasses both the practical knowledge of teaching and the research field of teaching and learning. It is focused on the process of education, or the “how” of learning (Kansanen, 2009). Didaktik conceives of teaching in terms of a dynamic model, which connects the content, the teacher, and the learner (Friesen, 2018).

Figure 6 illustrates the didaktik connection. The Didaktik triangle empowers teachers to translate state-issued curriculum guidelines through a relational lens, fostering a dynamic interplay between teacher, learner, and content. This relational approach contrasts sharply with the Anglo-American approach, which focuses on the content of education, or the “what” of learning— of which Friesen (2018) states, “In this case, the principal concern is not the translation of general directives to specific circumstances, but rather the attainment of measured ‘instructional objectives’ through ‘instructional procedures’” (p. 2).

Figure 6: The Didaktik Triangle



Note: Dynamic connection among teacher, learner, and content (Friesen & Osguthorpe, 2017).

The purpose of schooling within a Didaktik tradition is cited by Hopmann (2007) as “neither to transport knowledge from society to a learner (curriculum), nor a trans positioning of knowledge from various domains to the classroom, but rather the use of knowledge as a transformative tool of unfolding the learner’s individuality and sociability” (p. 115). Or as Bauer (1997) states: “It embraces a relationship between being and becoming, between the individual and the culture” (p.163).

Central to the Didaktik tradition is the concept of Bildung, which can be traced back to the Enlightenment and Romanticism and has been central to educational theory in Continental Europe since the 18th century (Sjöström, 2020). Interestingly, its influence extends even further, shaping educational traditions in some South American countries, like Brazil (Sjöström, 2017). A complex concept, the contemporary understanding of Bildung was redefined by educational theorists between the 1950s and 1970s and focuses on the development of individuals who can identify and follow their interests while being responsible citizens—the importance of self-determination, societal participation, and commitment to the common good are central features (Sjöström, 2020).

Where the Bildung-centred Didaktik differs from the Anglo-American concepts of curriculum and instruction is captured well by Sjöström (2020):

> Bildung was never understood as something one can be taught, but Bildung-oriented education is suggested as a way for everyone to support developing Bildung on their own. Bildung in a theoretical view is more of a concept of achieving capacity and skills than a set of facts and theories to be learned. Bildung is viewed more as a process of activating potential than a process of learning (p. 56).

In light of this view of Bildung, scholars like Deng (2015) grapple with the question of which knowledge and content can best equip students to achieve this ideal. This question echoes the inquiries posed by Bauer (1997): “What should they know?” and “What should they become?” To address these questions, Sjöström (2020) proposes three fundamental Didaktik questions to guide educators: why (intentions, aims, and objectives), what (topic of instruction and content), and how (methods of instruction and media used).

In today’s complex world, one marked by social, technological, economic, ecological, and political challenges, the concept of Bildung appears strikingly relevant. As Bauer (1997) aptly observes, “the very advancements of modern societies, particularly in science and technology, often come with unintended social and environmental consequences, raising the question: Could a renewed emphasis on Bildung bridge the gap between the complexity we’ve created and our capacity to address it?” (Bauer, 1997).

Now, more than ever, we need responsible and empowered citizens—individuals equipped with the knowledge, critical thinking, and ethical grounding necessary to navigate the challenges of our present and future. We must, therefore, revisit the question: What is the purpose of education in a post-modern world?

The Purpose of Education

The past two decades have witnessed a global shift in defining the core purpose of education around the development of 21st-century skills (Karseth & Sivesind, 2010). Driven by the belief that a specific set of competencies is crucial for students to thrive in an increasingly volatile, uncertain, complex, and ambiguous (VUCA) environment, a global movement is underway to integrate 21st-century competencies into school curriculums (Deng, 2021). This effort involves various stakeholders, including local bodies like the Ontario Ministry of Education and international organizations like the International Baccalaureate and the OECD. All stakeholders have developed competency frameworks that encourage the use of knowledge, skills, attitudes, and values to prepare students for future needs (See Table 3). This shift has led to a rise in competency-based curriculum approaches alongside a growing embrace of constructivist learning theory and learner-centred pedagogy (Deng, 2021). These approaches are believed to equip young people with the necessary skills to navigate the evolving demands of the future labour market (Horvathova, 2020). A flexible approach that adapts to changing trends and circumstances appears to be what is needed. In their report, “Workforce of the Future: The Competing Forces Shaping 2030,” which surveyed 10,000 people, PwC estimates that 60% of respondents felt that few people will have stable, long-term employment in the future. Additionally, 74% felt that learning new skills and re-training would be necessary to remain employable in the future (PwC, 2024). Blair Sheppard, Global Lead, Strategy and Leadership development at PwC ruminates:

> So, what should we tell our children? That to stay ahead, you need to focus on your ability to continuously adapt, engage with others in that process, and most importantly retain your core sense of identity and values. For students, it’s not just about acquiring knowledge, but about how to learn. For the rest of us, we should remember that intellectual complacency is not our friend and that learning—not just new things but new ways of thinking—is a life-long endeavour (PwC, 2024).

Table 3: Various System Level 21st-Century Skills/Competencies

	INTERNATIONAL BACCALAUREATE ORGANIZATION (IBO)	**ONTARIO MINISTRY OF EDUCATION (MOE)**	**ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD)**
SYSTEM LEVEL	Local School /International	Province	International
OVERVIEW	The IBO developed a framework for 21st-century education, which included competencies in 4 areas: 1. Knowledge: "What we know and understand" 2. Skills: "How we use what we know" 3. Character: "How we behave and engage in the world" 4. Meta-learning: "How we reflect and adapt"	The Ontario Ministry of Education emphasizes seven key competencies in an approach known as "learning for transfer," which integrates these competencies throughout the curriculum, engaging students cognitively, socially, emotionally, and physically	The OECD defines "skills" as part of a holistic concept encompassing a comprehensive approach to competencies, which entails leveraging knowledge, skills, attitudes, and values to navigate complex challenges effectively. They distinguish between three different types of skills: 1. Cognitive and meta-cognitive skills 2. Social and emotional skills 3. Practical and physical skills
SKILLS / COMPETENCIES / ATTRIBUTES	Creativity Critical thinking Communication Collaboration Mindfulness Curiosity Courage Resilience Ethics Leadership Metacognition Growth mindset	Critical thinking and problem solving Innovation, creativity and entrepreneurship Self-directed learning Collaboration Communication Global citizenship and sustainability Digital literacy	Critical thinking Creative thinking Learning-to-learn Self-regulation Empathy Self-Efficacy Responsibility Collaboration Using new information Technological communication

Note: Adapted from Horvathova, 2020; Ontario Ministry of Education, 2024; OECD, 2019.

Deng (2021), who aligns the term “human powers” with much of what is outlined above as skills, competencies, and attributes states that the key to educating students for a more uncertain future “is to *transform* disciplinary knowledge into educational purposes, into the institutional curriculum and into classroom teaching in ways that are conducive to the development of human powers” (p. 1654). This perspective reflects the ethos of the Continental European Didaktik, indicating that the two traditions are not mutually exclusive. Together, they offer a complementary perspective necessary for developing 21st-century competencies.

Relevance of Educational Theory to Teachers’ Perception

It is crucial to understand educators’ theoretical orientations, which are shaped by a complex interplay of ideological upbringing, professional training, and sociocultural context. Understanding these orientations offers valuable insights into educators’ decision-making processes and pedagogical approaches within learning environments. As Schiro (2012) states: “Curriculum ideology can influence people’s way of thinking about curriculum in the same powerful way that their political beliefs can influence their stance on political issues” (p. 2).

4.0 DEFINE

This section answers the research questions:

1. What affordances are perceived within the iCAST spaces examined?
2. How are the affordances of Branksome Hall's iCAST perceived by school leaders and teachers during the preoccupancy phase?

Three spaces within the iCAST were evaluated in this study: the Pitch Space, the Robotics / Design Space, and the Noodle/Ideation Garage. All three were evaluated for fit with Frelin and Grannäs' (2022) TEALE Model, an empirical model generated to facilitate research and discussion regarding teachers' preoccupancy evaluations of new learning environments. This model identified patterns associated with three key themes in the data: material affordances, organizational affordances, and educational affordances. My data was coded for spatial qualities associated with each of these themes in a deductive manner. However, I also applied inductive coding to capture two additional themes outside of this framework that were unique to Branksome Hall's context: nurturing affordances and values-oriented affordances. All codes applied under each theme can be viewed in my codebook (see Appendix C). In this section, I begin by providing an overview of each theme, followed by a summary of seven insights generated from my analysis of these themes.

4.1 THEME SUMMARIES

This study adopted Frelin and Grannäs' 2022 TEALE analytical model as a framework for data collection and analysis. Below is the overview of themes empirically generated for the TEALE model that were applied in this study.

MATERIAL AFFORDANCES

Frelin and Grannäs (2022) define the material aspects of the learning environment as elements that shape the physical space and its impact on learning; they are identified as those things that relate to where learning takes place. Material aspects of the learning environment are only considered to be affordances when they are tied to a specific educational activity. These types of affordances help teachers understand the spatial aspects that influence their decision on where to teach, which is a crucial consideration in curriculum theory.

ORGANIZATIONAL AFFORDANCES

Organizational affordances of the learning environment are defined by Frelin and Grannäs (2022) as those features that allow for the organization of time and space. Two types of organizational affordances are considered:

- People and groupings: Who will be in the space and how it will be arranged.
- Time and space structures: The timetabling, scheduling, and curriculum that provide optimal organizational structure for successful educational activities.

Educational activities can only be carried out if the organization of people in the space affords it. These types of affordances help teachers understand who and when to teach, which are critical questions related to curriculum theory.

EDUCATIONAL AFFORDANCES

Educational affordances are defined by Frelin and Grannäs (2022) as spatial features that allow for educational activities. They can be general or specific in nature and are often entwined with both material and organizational affordances.

Educational affordances prompt teachers to ask, “why this space?” and to consider if the purpose of the activity matches the affordance of the space. In this way, educational affordances also address the question of “how” the space will be used. The question of why, is a key question in the didaktik tradition.

The following two themes were inductively generated out of the dataset and reflect observations of affordances unique to Branksome Hall.

NEW THEME 1: NURTURING AFFORDANCES

Nurturing affordances are viewed by this study as those features which produce an optimal environment for wellbeing and create an inviting atmosphere. These affordances were observed as being entwined with both material and organizational affordances. The elements of physical space as well as its organization give rise to an affordance of a more intangible quality that participants indicated was attractive to fostering innovative teaching and learning practices; an elevated feeling or atmosphere created by the space. Nurturing affordances can, thus, be applied to teachers’ decision-making around social and emotional engagement with learning.

NEW THEME 2: VALUES-BASED AFFORDANCES

Values-based affordances are viewed by this study as those features which engage Branksome Hall’s school values: creativity, sense of community, making a difference, and inclusivity to activate student

potential. Values-based affordances were observed as being entwined with both nurturing and organizational affordances. In other words, the elevated feeling or atmosphere of the space and its organization were seen to promote spatial engagement practices that unlock innovative learning opportunities that align with the school's core values.

4.2 INSIGHTS

The following insights were generated from my analysis of the dataset, which employed deductive and inductive approaches. The insights used frame my interpretation of the significance of each theme across the spaces examined in the spatial analysis that follows.

STUCK IN ORTHODOXY

Educators established mental model of "what school looks like" (e.g., traditional classrooms, desks, and lectures) subconsciously limit their ability to perceive the affordances and possibilities offered by the iCAST. This ingrained schema acts like a filter, making certain aspects of the new space invisible or confusing while highlighting elements that align with their pre-existing expectations.

SPATIAL LITERACY IS A 21ST CENTURY COMPETENCY

This competency is important for all educators, regardless of their subject area or prior experience with embodied learning. Without this competency, the innovative environment risks becoming underutilized by educators lacking experience with flexible spaces. Therefore, it creates an inequitable learning experience—for students exposed to different teaching approaches and traditional pedagogical approaches and static classrooms might persist, hindering the full potential of the iCAST.

HARMONY IN THE HUDDLE

Both teachers and leadership bring valuable knowledge and priorities to the table when evaluating the material and organizational affordances inherent in the iCAST. While teachers tend to prioritize immediate material and organizational affordance needs relevant to praxis, leadership adds a future-forward layer of vision often linked to strategy and research-based knowledge. Building a shared understanding is essential for creating activation strategies that leverage teachers' and leadership's knowledge and priorities. Thus, leading to a more successful and sustainable implementation of the innovative learning environment.

THE CLASSROOM: TRANSFORMATION OF VS. ADAPTATION TO

The perceived purpose and potential of the innovative learning environment diverges somewhat between teachers and leadership. This perceived purpose suggests that fundamentally different values and goals are attached to the space, which shapes how each group envisions its use. Teachers currently view the

space as “a different classroom,” contemplating how to adapt existing teaching methods to fit spatial affordances. Leadership sees the space as a catalyst for transformative learning experiences beyond adapting old methods. Working collaboratively to activate the space will open space for an evolving mindset from classroom to learning environment and will ensure that the innovative affordances and transformational potential of the space will be realized.

CROSS-POLLINATION: NURTURING MOTIVATION WITHIN A FRAMEWORK OF SUPPORT

Teachers’ desire for interdisciplinary collaboration is currently hampered by structural constraints like timetables and scheduling, space limitations, and IB Diploma Program (Grade 11/12) curriculum demands. Thus, suggesting a need for systemic solutions that support and incentivize cross-curricular collaboration. Systemic supports are necessary to bolster the rich connections and deeper understanding fostered by inter/transdisciplinary learning, which is a goal of the iCAST.

IF YOU BUILD IT, WILL THEY COME?

Existing timetabling structures and perceived “cost-benefit” considerations related to booking lengths and “transit time” are perceived as a barrier to equitable access and optimal utilization of the iCAST. Without a streamlined, flexible booking process tailored to meet the needs of the junior, middle and senior school, teachers may be deterred from pursuing potential benefits of the spaces due to perceived limited or inconvenient booking options. Additionally, teachers perceive needing extra time to teach technology skills, which detracts from content delivery time. A current lack of clarity on students’ digital proficiency could lead teachers to bypass technology-rich spaces, which results in missed opportunities to develop essential digital skills through authentic learning scenarios.

SPACE ODYSSEY: THE LEARNING FRONTIER

Educators unfamiliar with embodied learning approaches are likely to find that the affordances of the iCAST spaces clash with traditional teaching methods. This potential disconnect between the spaces’ intended use and their actual implementation poses a challenge to realizing the pedagogical benefits of the space, particularly in middle school. Moreover, true inclusivity requires adapting these spaces to accommodate the diverse needs of all students, ensuring everyone can access and benefit from their offerings.

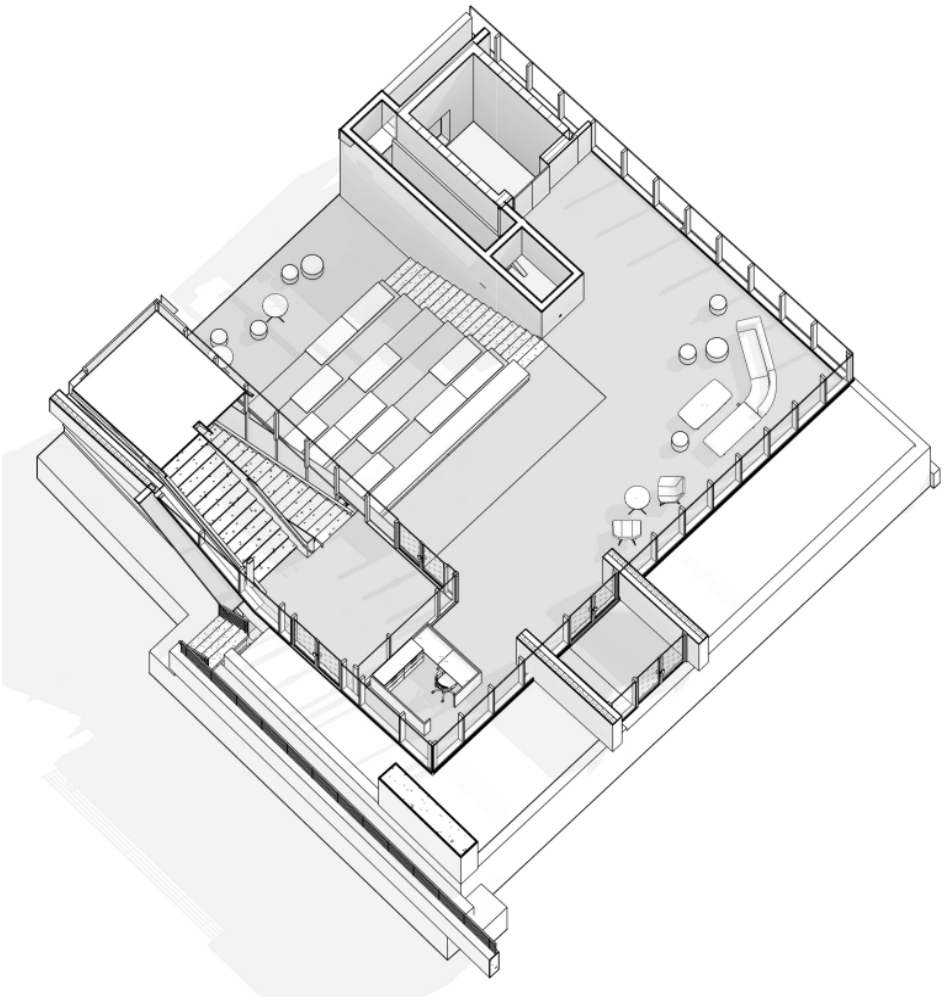
4.3 PERCEIVED AFFORDANCES

PITCH SPACE

The lower-level Pitch Space is primarily characterized by a central “learning staircase.” There is a retractable glass wall that separates this space from the robotics lab, small alcoves provide semi-private space on either side of the bottom of the staircase, and there is presentation/performance floor space at the base of the stairs. A glass wall on one side of the space allows a view of people moving between building levels on the stairs.

Spatial Overview:

Figure 7: Pitch Space and Entrance Mezzanine, Axonometric View



Note: From Ennead & MJMA Architects, 2024, “Pitch Space and Entrance Mezzanine,” Axonometric View. Used with permission.

Figure 8: Participant View of the Pitch Space in Virtual Reality

Note: This is a screenshot from Branksome's 360 Experience, developed by Cicada Design (2023). Used with permission. The image above is a screenshot. The participants had a 360° view.

Material Affordances

Table 4 provides an overview of the most perceived material affordances of the Pitch Space. Participant perceptions of this space point to a multi-functional space that is ideal for interdisciplinary, collaborative, and information-delivery learning, given the large area for presentations, showcasing student work, and technical/artistic demonstrations. Smaller alcoves allow for focused collaboration, feedback sessions, and personalized instruction.

Table 4: Material Affordances Perceived by Teachers and School Leaders in the Pitch Space

SPATIAL FEATURES	ACTION POSSIBILITIES
LARGE GROUP AREA	• Space to showcase student projects and demonstrations. • This space could include tech demos, impromptu displays of work from makerspaces or Robotics Labs, or sharing interesting works in progress from the Arts with other students and visitors. • Incorporate display areas or interactive stations to encourage engagement and curiosity.
LEARNING STAIRCASE	• Large size of the space makes it suitable for presentations and debate. • Teachers can incorporate direct instruction, student-led presentations, debate, and reflective activities in this area. • ATL skill development: Effective presentation techniques, public speaking skills, and active listening.
ROBOTICS ARENA	• Retracting the glass wall allows for the Pitch Space to evolve as an important adjoining space for the Robotics Space to facilitate project flow and collaboration. • The Pitch Space can become an amphitheatre for robotics performance and provide additional floor space for testing robots. Planked seating allows for small groupings and iterative workspaces.
SMALL ALCOVE SPACES	• Breakout spaces within the pitch area provide opportunities for students to collaborate in smaller groups. The two alcoves and lobby area are spaces where students can gather to refine their work, practice skills, and provide feedback to one another. • Small alcoves provide a space for teachers to work 1:1 with students requiring personalized support or private conversations.

The Pitch Space represents perhaps the most novel of the three spaces evaluated by educators, as its design and layout are entirely different from a traditional classroom. The history of stairs as a focal point for entry and connection dates to the first human structures; however, as a concept, it is not new. Its presence in ILEs as a defining feature of 21st-century educational spaces is a multipurpose active design concept that stimulates movement, encourages passive seating, and fosters community (Willson & Winebrenner, 2017). This merging of historical utility and more modern adaptation is reflected in the architect's described intention for the Pitch Space:

> The idea of the Pitch Space remains central to the design in that there is a kind of entrepreneurial and performative undertone to everything that's going on in this building. And that's centred around the Pitch Space. So, the Pitch Space is a place where you present or are presented to. It's like a Greek amphitheatre; it's about performance. In a way, the Pitch Space is a mini version of the of

> the theatre, the actual iCAST theatre. And it kind of just mirrors its performative functions on a smaller scale and doubles as a place for social gathering.

Throughout the VR walkthroughs, it was evident that the Pitch Space challenged the mental models of educators whose disciplines are less embodied. Thus, it was confusing for them to imagine how typical lessons could translate into the space. For example, one SMS teacher stated:

> I wouldn't do, like, class discussions here, right? Because you're not in the round. So, it's because, when we have class discussions, you need to be facing one another. And not sort of be in an audience and presenter-type environment. So, I wouldn't do those types of activities.

Throughout the VR walkthroughs, I noticed that some participants had difficulty responding directly to the question: "How might you use this space for your current practice?" The question was meant to solicit specific examples. However, it often shifted to "I like" statements, which indicates a willingness to imagine themselves in that space, despite not yet knowing how to use it. Thus, the capacity of many participants to recognize space as an affordance was limited to the need for professional learning around spatial competence. Exceptions exist, however, particularly among educators who teach more embodied subjects like the Arts and Phys Ed. Their spatial awareness is crucial for curriculum development and delivery. As such, one senior leader highlighted the need to develop spatial capacity in educators across all disciplines:

> I think we really need to step into supporting our educators to know how to use these spaces. Being a drama teacher, I'm very comfortable with an informal desk-less space like this. But I think that can be a barrier for some folks or they can feel frustrated because they don't know how to control the flow. In the junior school classrooms of the future, we saw that the teachers needed to figure out different ways of setting those class norms.

Those affordances that were most perceived in the Pitch Space by teachers are not a stretch to envision, the learning staircase and large open spaces are similar to current auditoriums where presentations, debates, and demonstrations are currently afforded. For instance, one SMS teacher characterized the utility of the Pitch Space this way:

> So, I can see the stairs, students can listen to a speaker. So, if we have a speaker for careers in STEM and math, I could see bringing students here for that. There's an opportunity for student presentations. This might be a good space for that.

Many of the spatial features that were “less perceived” by teachers are not commonly found in traditional classroom spaces (e.g., Robotics Arena, adjoining spaces, and tools/tech). Particularly, school leadership participants perceived a strong connection between the Pitch Space and the adjoining Robotics Space, which does not appear to have been considered by teachers at all. Several school leaders note the expanded possibilities afforded when retractable walls open up the space, creating new opportunities for the roles of performer and audience.

> And then by having the adjustable partitions, removable partitions, you can go from that, individual privately acoustic separated space to one wide open space, like this space (Robotics / Design Lab) ...and this extends the idea of the performance to the Robotics Arena, all becomes possible by opening up the centre core of the entire room.

Other less perceived features, (e.g., connectivity, large screens, and worksurfaces) are features that were more inferred than visible during the VR walkthrough. Their ubiquity in traditional classrooms can lead teachers to overlook their significance as features that afford various learning experiences. The lack what would be perceived as traditional worksurfaces (e.g., to write on) presents an opportunity for students and teachers to engage creatively to consider alternative forms of engagement in this learning space. These less perceived features highlight the idea that teachers will interpret their environments in accordance with their knowledge repertoires, spatial competence, and the idea that, historically speaking, the question of where to teach has not been as prominent as what and how to teach (Frelin & Grannäs, 2022). Building on this point, there is a notion revealed in the data that the features of the building will elevate program offerings. One school leader commented: “I think the stairs will enable students the opportunity to pitch in a more professional manner, and it will train them for debating.” Though not a new concept, it is prudent to remember that we must not put the onus for innovation or elevated offerings on the building. Instead, consider the teacher’s understanding of how to use the building to achieve aspirational outcomes. The physical environment is not a substitute for effective teaching and planning, rather, as Martin, (2002) points out. It is the teacher’s skilful role that creates the learning environment within an architectural facility.

Organizational Affordances

Table 5 provides an overview of the most perceived organizational affordances of the Pitch Space. Participants valued the space’s flexibility for diverse groupings, enabling multi-modal learning (e.g., presentations, debates, and performances) for large audiences. Retractable walls allow for the organization of space to support team teaching, interdisciplinary collaboration, and community engagement activities.

Table 5: Organizational Affordances Perceived by Teachers and School Leaders in the Pitch Space

SPATIAL FEATURE	ACTION POSSIBILITY
LARGE GROUP CAPACITY	• Allows for multi-modal learning: presentations, performances, lectures, discussions, and debates • Enables larger groups to come together: multiple sections of a course, different age cohorts, and internal/external community members • Showcase of learning space
AUDIENCE	• Opportunity for practice • Active participation and exchange of ideas between the audience and presenters, and between audience members • Sharing of skills and knowledge with various audiences (e.g., students, staff, and community members) through critique, feedback, interactive presentations, and participatory arts productions
RETRACTABLE WALLS	• Adjustable room capacity • Ability to connect or separate spaces • Supports team teaching
TIMETABLING	• Regularly scheduled inter/transdisciplinary activities between different classes and grade levels • Interdisciplinary planning time

The Pitch Space's organizational affordances encompass its physical design elements and the underlying structures that facilitate desired educational activities. The architect, in describing the space's purpose, emphasizes its role as a central hub within the building:

> The glass and the central stair are designed to be transparent, bright, and exciting. It speaks to, you know, movement, circulation, and connections. So, by making it [the Pitch Space] as transparent as possible to be viewed from both the street and internally, that transparency and connection theme is a centre point that ties the whole building together—functionally, and I think metaphorically, in a way too.

Though not frequently mentioned, the glass walls—a key affordance alluded to by the architect in terms of fostering a sense of connection—received mixed reviews from teachers and school leaders regarding their impact on student engagement. One SMS teacher saw them as potentially positive, highlighting the inspirational effect of seeing others engaged: "I quite like it (glass wall), because I think it can be a little bit inspiring to see other people engaged in activity." The participant acknowledged the potential downside of distraction but expressed a hopeful view: "So, you know someone could argue that it could be distracting because you're seeing other things going on. But I actually would hope for the opposite.

Because when you're seeing other people working hard, and being engaged, then you want to be a part of it, too."

Another SMS teacher, however, raised a concern about distractions, particularly for students near the glass staircase: "I guess what I am worried about is the (glass) staircase on my right. The people coming up and down might distract the students when they are listening to a speaker or doing a presentation." This concern about openness and transparency leading to distraction was echoed by several other teachers, especially regarding its impact on neurodiverse students. One teacher expressed it this way: "When I think about our neurodiverse students, I wonder about the design in terms of sensory overload. Because there's a lot going on with other interesting things which could be distracting."

The teacher's perception of the glass walls as a negative affordance could be because teachers are not traditionally accustomed to thinking about their classrooms as affording "learning on display" as an outcome. School leadership participants, however, viewed the space through a teaching and learning lens, considering the potential for nurturing curiosity through proximal learning in peripheral spaces. Through a school admissions lens, they also made several mentions of the Pitch Space as a key space to leverage learning on display. One school leader highlighted this dual purpose, emphasizing the development of public speaking skills and confidence alongside the concept of "learning on display":

> And what might that (e.g., presentations and performances in the Pitch Space) open up in terms of developing public speaking skills and confidence? But also putting learning on display—other stakeholders might be walking across the top in the lobby area or across the bottom and be able to engage with whatever is happening down along the slope. Likewise, going up and down the stairs, being able to see into what's happening here, is also about making learning visible.

Teachers saw more potential for both small group and large group activities here, and an audience featured highly as an organizational affordance perceived by teachers. Leadership participants perceived the space to have opportunities for flexible furniture arrangement, whereas teachers seldom mentioned this benefit. This discrepancy may be because the Pitch Space is rather static in its configuration of the central stair feature. However, there is potential to add soft architectural features at the top, bottom, and side alcoves to support various types of groupings. Additionally, teachers are not always motivated to re-configure classroom setups because of the impact on content teaching time. One SMS teacher describes the tension this way:

> I can't lie...I work with what the desks are like when I get into the space. I can't be bothered to move it…I'm like, well, I'll just work with what's in front of me because I don't want to spend time moving everything.

This sentiment is consistent with the findings of the 2020 IELTC project on teacher's transition to ILEs. One spatial constraint revealed that "the time and effort required to rearrange tables and chairs to facilitate student collaboration meant teachers often avoided utilizing this valuable affordance" (p.329).

There were few mentions of using this space as an individual work zone. However, when considering the Pitch Space as an extension of the robotics/design space, some participants acknowledged that students may wish to break out and iterate on individual projects. When booking the Pitch Space alone, it is perceived to be better suited to larger group activities.

Community building, a core value at Branksome Hall, was mentioned by several participants in the context of fostering collaboration between the Middle School (MS) and Junior School (JS). However, some participants saw the potential to extend this concept even further. Building on the growing notion of "schools as community hubs" (Cleveland et al., 2023), they envisioned the space being used for collaboration with members of other schools and with community partners to foster integrated and resilient communities centred around education. This vision resonated with an SMS teacher who shared a concrete example of community building that she already implements:

> We have our Grade 10s share projects they're working on with the grade sixes, but I always feel like there should be more. That's how you create a sense of community in a school like this. It gives the older one's opportunities to mentor and to share. So, a space like this could be really great for that kind of thing.

The participant data from teachers indicated a strong desire for more collaboration on interdisciplinary projects but teachers currently wrestle with a feeling of constraint that stems from the timetable, available spaces, and in the case of the older grades, (11/12) the curriculum. Scheduling, in particular, was a common constraint cited by teachers keen to work in a more interdisciplinary seam:

It'd be very cool to be collaborating between courses. I mean, this building is ideal for that, especially for things that are outside of a traditional schedule. I'd love to be doing more, even if it's not like a formal IDU, more collaboration between courses is super interesting. But it requires, a choice on behalf of the school because sections would have to be timetabled against each other.

Educational Affordances

Table 6 provides an overview of the most perceived educational affordances of the Pitch Space. As detailed below, participants described the space as a multi-functional environment offering a large, open area for presentations, workshops, and performances alongside smaller alcoves for focused

activities like peer learning, assessment, and presentation preparation. The high ceiling and open design provide equitable viewing for large group activities and can even accommodate experiments requiring a controlled environment.

Table 6: Educational Affordances Perceived by Teachers and School Leaders in the Pitch Space

SPATIAL FEATURE	**ACTION POSSIBILITY**
SMALL, ALCOVE SPACES	• Peer learning and assessment • Semi-private space for presentation preparation
LARGE GROUP AREA	• Direct instruction or lecture • Group discussion • Group collaboration • Presentation • Workshop • Performance • Pitch • Guest speakers • Peer learning
LEARNING STAIRCASE	• Equitable viewing opportunities. • Communal space that encourages conversation, connection, and collaboration • Impromptu, informal seating area • A space for displaying artwork and a place for staging activities • Promoting circulation and physical well-being—learning stairs incorporate standards associated with the WELL building condition on Interior Fitness Circulation (International WELL Building Institute, 2020)
SPATIAL OPENNESS/ HIGH CEILING	• Experiments requiring a controlled environment or high ceiling

Study participants discussed educational activities based on their current practices and how they envisioned utilizing the space in the future. Most focused on general activities like group discussions and presentations, with few exceptions venturing into more specific possibilities. Interestingly, neither teachers nor school leaders saw the Pitch Space as ideal for focused activities like brainstorming, problem-solving, or homework. They may have envisioned these activities taking place in more traditional classrooms

with desks or tables rather than on stairs as dictated by their prior experience. The extensive use of glass walls in the Pitch Space may also have influenced these perceptions. Both teachers and school leaders expressed concerns that the openness afforded by the glass could be distracting for those engaged in focused learning activities. Their perceptions and concerns raise some key considerations for the activation phase of the building. One SMS teacher noted the need for “some teaching involved” in managing student flow within the open space. This need highlights the importance of a collaborative approach among students, teachers, and school leaders. Working together, they can co-design appropriate behaviour and movement patterns to minimize distractions, such as designated walking areas or quiet zones.

Both SMS and JS teachers expressed concerns about students who might require differentiated instruction in such an open environment. These teachers suggest that through incorporating universal design principles, accommodations can be developed broadly and specifically to meet the needs of students with learning strategies and plans, ensuring all learners can thrive in these open environments. Finally, the open and visually stimulating nature of the space suggests it may be best suited for lower-stakes, practice-oriented activities, particularly for younger grades. This solution aligns with a concern raised by an SMS teacher regarding “high stakes” environments for students who are easily distracted.

Other participants saw the openness of the space as an asset. One SMS teacher highlighted the comfort students might experience in the open space, describing the seating as reminiscent of a university-style layout. An educational consultant participating in the study echoed these sentiments, highlighting the space’s potential for individual use:

> It’s not as if pitches are going to go on here all the time. Even as the girls are sitting there, this may be a place for someone to do some independent work. They may come and sit down here with a laptop and do some work. You know, so not everything has to be collaborative space. When you see stairs like this, particularly outside public buildings, it’s full of people. They can find their own private space on this sort of setup.

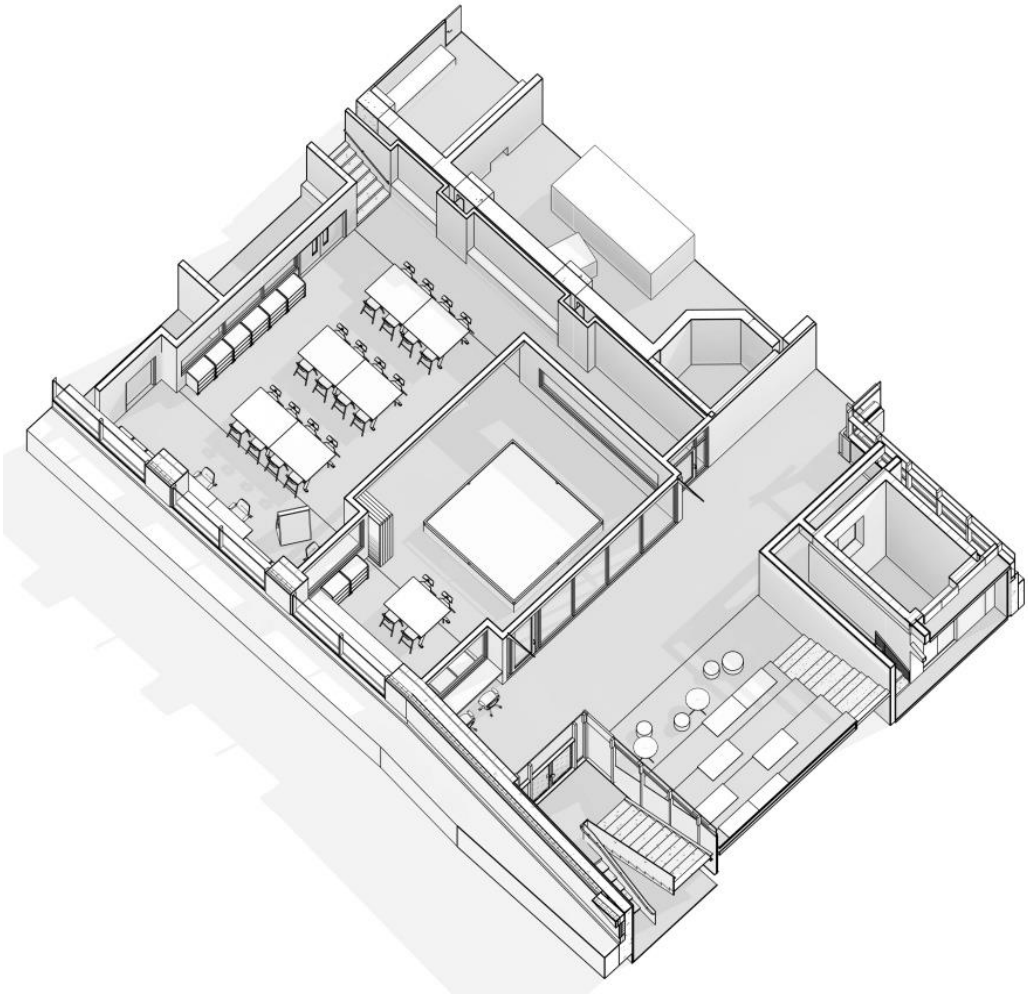
There is a common thread between these comments: The Pitch Space is a flexible, adaptable space that will see the perception of educational affordances grow and develop as the school learns from others, experiments themselves, and observes how students gravitate towards their use.

ROBOTICS/DESIGN SPACE

The Robotics/Design Space is adjacent to the Pitch Space on the lower level of the iCAST. There are retractable glass walls on either side of the Robotics Space, one that separates robotics from the Pitch Space and one that separates robotics from the Design Space. There are built-in and mobile storage solutions, a sidebar workbench, doorway access to the wood and metal shops, a Robotics Arena, and mobile and reconfigurable tables and chairs.

Spatial Overview:

Figure 9: Robotics and Design Space, Axonometric View



Note: From Ennead & MJMA Architects, 2024, Lower-Level Robotics / Design Space, Axonometric View. Used with permission. Shown adjacent to Pitch Space.

Figure 10: Participant View of the Robotics Space in Virtual Reality

Note: Screenshot from Branksome 360 Experience, developed by Cicada Design (2023). Used with permission. The image above is a screenshot; the participants had a 360° view.

Figure 11: Participant View of Design Space in Virtual Reality

Note: Screenshot from Branksome 360 Experience, developed by Cicada Design (2023). Used with permission. The image above is a screenshot; the participants had a 360° view.

Material Affordances

Table 7 provides an overview of the most perceived material affordances of the Robotics / Design Space. Participants perceived these multi-functional workshop spaces to cater to both focused individual work and collaborative projects. Separable wood and metal working areas allow for dedicated manufacturing processes without disrupting other activities. Multiple work surfaces and adjoining adaptable spaces facilitate group project assembly, testing, and differentiated learning approaches.
The close proximity to the Pitch Space and specialized workshops streamlines the project design cycle.

Table 7: Material Affordances Perceived by Teachers and School Leaders in the Robotics and Design Space

SPATIAL FEATURE	ACTION POSSIBILITY
SEPARABLE WORKSHOP SPACES (WOOD/METAL)	• Dedicated areas for focused work • Manufacturing process work without noise, dust, and disruption to other spaces
MULTIPLE SURFACES TO WORK ON	• Group collaboration • Project assembly and testing • Independent work • Differentiation and personalization of process work
ADJOINING SPACES	• Adaptable space capacity • Movement, interaction, and observation among students and teachers • Close proximity of pitch, robotics/design, and specialized workshops ensure student projects benefit from an easy transition between each phase of the design cycle

It might seem strange that the Robotics Arena wasn't mentioned more here. But the dataset showed that as a classroom activity, the use of robotics in the SMS is not very common outside of science classrooms. That is perhaps because SMS teachers are subject specialists rather than generalists, as in the JS, where robotics is more fluidly integrated across the curriculum. While some SMS participants saw potential in the robotics space, they also viewed the immovable features as a potential obstacle unless adjoining spaces could be booked simultaneously. One participant acknowledged this by stating, "Well, having the ability to open up this space means that the limits of this unmovable arena can be somewhat overcome." This concern aligns with a sentiment expressed by a JS teacher, who highlighted the need for open floor space for testing alongside the dedicated robotics area: "So I think that the shape and space itself is good for robotics to have a contained space. But sometimes you just want floor space (for testing)."

The perceived tension between traditional teaching methods and the iCAST's functionalities was further highlighted by some teachers who struggled to envision themselves using the Robotics/Design Space. As one SMS teacher candidly admitted,

> I've got to be honest; I don't really see this being a space for my classes at all. Okay, like I don't. I don't see how it would connect unless we were doing some kind of an interdisciplinary unit that required some type of building, right, constructing something or programming something. Okay, so I don't even know what that would be. I do not see this as being at all remotely relevant to anything in my classes.

These sentiments could be interpreted in a few ways; there is concern about covering curriculum content and not wanting to "waste time" on innovative approaches, which was a common feeling among SMS teachers. One SMS teacher positioned it this way: "Kids just want to get the work done. And teachers just want to get the work done at the end of the day. So, unless there's a real add, I just don't know…" These statements from teachers highlight discomfort with recognizing the affordances of such unfamiliar spaces, pointing to a need to challenge teachers' mental models, perhaps through facilitating workshops to critically examine our notions of "school" and exploring the possible futures of "what school looks like." Teachers must be offered support and guidance to gradually and respectfully expand their comfort zone in a way that empowers them to unlock the potential of the ILE spaces for their unique purposes. As part of their work with the ILETC project investigating how teachers adapt to innovative learning environments, Mahat and Imms (2020) offer 14 broad themes to consider that support educators' capacity for innovation through a framework that guides the transition from traditional classrooms to ILEs. This work was designed to be adapted to unique school contexts. It can be used by leadership at Branksome Hall to support the activation of the iCAST and as an opportunity to contribute to ongoing research.

Though small breakout spaces are possible to configure in this space, more mentions were made of the utility of this space for students to spread out and work collaboratively. Participants who commented on the importance of adjoining spaces for the robotics/design spaces tended to be those already familiar with highly flexible and spacious environments, such as Arts and Physical Education teachers. This utility reinforces Horne Martin's (2002) notion that all teachers, not just those in embodied learning disciplines, should develop spatial competencies alongside lesson planning skills. Space can be a powerful teaching tool and should be considered when planning learning experiences. School leadership recognized the potential of the space to support the flow of project-based learning and the design cycle; one school leader described the benefits of the adjoining space this way:

> You can move between various single-user spaces at the bench area. Then, it flows into (an area with) a digital screen. So, I think it allows for a high level of personalization. I think it allows for a

> highly differentiated experience. There's personalization in terms of moving through your material, and really through the design cycle.

Another leader expressed: "...proximity to the woodshop and metal shop in the back means that people can flow from this space into a woodshop, for instance, fabricate something and bring it back out here for assembly, for testing."

While leadership largely perceived the spaces' long-term potential for personalized learning and interdisciplinary project-based learning through the design cycle, teachers' perceptions prioritized immediate functionality around issues of capacity, logistics, and safety. For example, one SMS teacher contemplating a science project in the workshops posited:

> If I imagine bringing a class in here, let's say there are 15 plus students and some of them are in the metal shop, some of them are in the wood shop, then who is supervising them? And who is supervising the main space?

One JS teacher thinking about similar logistics asked this question about the Robotics Space:

> I'm curious about how it would be used because I'm thinking we have 24 kids in a class. And what's the capacity in this room? I'm thinking that if I have 24 grade one students, we'll do things in centres. So, if I was doing a centre with grade one students and I'm using a space like this with a little group, then this would be ideal...but my question is, what if it's a whole class?

Teachers' responses and questions align with the types of questions related to the purpose of education. Thus, they have such a preconceived notion of a lesson's purpose that they have been conditioned through curriculum theory to ask: What lesson am I teaching? Where am I teaching it? How am I teaching it? (Biesta, 2009). Leadership's perception reflects a more ideal state rooted in theoretical or research-based knowledge. Finding common ground between the practical needs and long-term vision is crucial for successful activation of the iCAST spaces.

Organizational Affordances

Table 8 illustrates the organizational affordances most perceived by participants in the Robotics/Design Space. These spaces were perceived to cater to small groups and individual project-based learning experiences. Retractable walls allow for flexible room configuration to manage small groups or larger gatherings for team teaching and collaboration. The space fosters a culture of making and exploration, encouraging mistakes and experimentation. The open environment welcomes support staff and external partnerships, creating a space where students, faculty, and the community can learn and create together.

Table 8:Organizational Affordances Perceived by Teachers and School Leaders in the Robotics and Design Space

SPATIAL FEATURE	ACTION POSSIBILITY
SMALL GROUP	• Small group, individual, and independent work • Spatial separation from other groups
RETRACTABLE WALLS	• Ability to manage larger groups • Supports team teaching
SUPPORT STAFF	• Allows for higher-level (more complex) projects supported in a safe environment • Contributes expertise for learning and capacity building of both students and faculty/staff • Fosters real-world applications • Supports team teaching/collaborative approaches to planning
CULTURE	• Partnerships and collaboration with broader school and local community • Time and space to support building capacity, creativity, and imagination (tinkering) for both students/staff • Mistakes, messes, and noise are a welcome part of learning • Porous educational spaces (not just a teacher and their immediate students in the space) • Project-based/maker culture

While engaging with this space, several participants mentioned the need to have a better understanding of students' technological skill abilities at each grade. There is a perceived barrier to using these spaces to enhance curriculum outcomes due to the time investment required to teach students the necessary skills. This concern centres around sacrificing content delivery time for skill-building. However, if students are already confident in their skills and teachers are aware of those skill sets, it may open up more opportunities to apply project-based learning. One SMS teacher reflected on the time commitment involved:

> I feel like, if the students need to learn a new design skill, it takes a significant amount of time for them to feel somewhat comfortable or confident with it. So, are you using curricular time from your course to do that?

This feeling was particularly pronounced among IB diploma program teachers:

> This space would be useful if you wanted to shift to a more project-based learning focus. Could you do that in the IB diploma? I feel like, not really. You could do that maybe if we didn't focus on the IB as heavily.

There is also a view that using innovative spaces and employing project-based learning is a tool to "motivate" students and that these approaches might be better applied with younger students and less necessary with older students. One SMS teacher expressed it this way:

> I teach predominantly Grade 11 and 12. So it's kind of like, would we use calculus and apply it here? I don't know. I'm just not sure what the added value would be of the physical making. Because in the middle years, I think, that type of engagement is really important and interesting for the students. But by the time they're in higher levels, they're already interested in the math. It's not like I need that motivator to engage them.

The perception of time was expressed similarly between JS and MS teachers regarding the need for longer blocks than the current timetable offers. For example, one JS teacher reflected:

> With all these spaces, I don't see myself wanting to book them as a one-off. Like, I feel like I'd want to work on a mini-unit of inquiry with a little project in here. You need time for the students to get used to the space and understand the norms so that you can start class right away. Otherwise, the time involved with getting here, getting people organized, oriented, and leaving is just too much.

This insight leads to a series of crucial questions. Who is this space for, and what timetable structure best supports practical and curricular needs? Additionally, how can we equip students and teachers with a baseline proficiency in technical applications and the tools and machines available? One teacher highlighted a key concern related to accessibility:

> I'm not sure if the word intimidating is correct, but there's a lot of equipment. There would have to be some training and onboarding with the students. So, finding the time to dedicate to that training is always at a premium. So, if we're going to use this space, we should make sure that students are comfortable in it. That might be a challenge—how do we carve out the time to make sure that they, and we, feel comfortable and safe using the equipment?

Both large group and individual use of these spaces were less frequently mentioned by teachers and leadership. The perception was consistent that these spaces were best utilized for small group projects

and activities. Large groups might have a difficult time into a hands-on learning space given how much space is taken up by equipment, tools, and work surfaces. This view is not surprising as the iCAST has other spaces more geared to large group learning.

Teachers made more mention of supports in the form of expert technicians and opportunities to collaborate and support the development of innovative programs. However, leadership made more mention of how this space can establish a culture of tinkering, innovation, and capacity building. This culture is related to the school's mission, vision, and values. One senior leader expressed the desire to nurture a culture of tinkering this way:

How do you have stuff and not have it so programmed up and not have people so programmed up that it makes it possible for someone to go over and just kind of tinker and fiddle with things? It's not necessarily in service of a particular moment in the curriculum, but it does serve students' building capacity through curiosity and imagination.

To build on this thought, an SMS teacher suggested that low-barrier entry "tinkering stations" might be set up in various small corner spaces around the school as a provocation to engage the innovator mindset.

Educational Affordances

Table 9 illustrates the educational affordances most perceived by participants in the Robotics / Design Space. This large, open maker space caters to project-based learning and fosters collaboration, group discussions, and brainstorming with space for movement and easy access to tools and materials. The adaptable layout of the Design Space allows for individual or group work, with flexible furniture to accommodate different work styles (e.g., sitting, clustering, and standing). It supports differentiated instruction, allowing students to choose their working style and location based on their needs. Expert staff are available to assist with complex projects, presentations, and workshops, fostering real-world applications and team-teaching opportunities.

Table 9: Educational Affordances Perceived by Teachers and School Leaders in the Robotics and Design Space

SPATIAL FEATURE	ACTION POSSIBILITY
LARGE, OPEN DESIGN / MAKER SPACE	• Group collaboration • Group discussion • Project-based learning • Movement and agency in students who can easily access tools and materials • Flexibility to sit, stand, and work individually or in a group • Build, model, and make
ADAPTABLE SPACE	• Brainstorm • Ideation • Problem solving • Peer learning • Team teaching • Student choice in how they are comfortable working and where they would like to work • Differentiated Instruction: students work where they are at • Teachers play to their strengths • Space to move around for more active learning pedagogies
EXPERT SUPPORT STAFF	• Delivers presentations and workshops • Allows for higher-level (more complex) projects supported in a safe environment • Contributes expertise for learning and capacity building of both students and faculty/staff • Fosters real-world applications • Supports team teaching and collaborative approaches to planning

As a group, school leadership didn't see specific activities as being afforded in this space. It was the general aspects and process of the design cycle that they perceived to be afforded. For example, leadership generally noted that this space "is the design cycle in action" rather than pointing out specific activities that might take place. Similarly, the Robotics and Design Space was not perceived by teachers to have many affordances for specific educational activities for their current practice. However, in the absence of being able to fully connect the utility of the space to their discipline, teachers and leadership described what they liked about the space, indicating a willingness to uncover the potential:

> I like that the tables are large. They're also collaborative spaces, which is great when students do projects together, particularly in a junior division. I love that there's lots of counter space to give students the opportunity to kind of stand up and work at different places.

> I really love the workbenches here. Students can spread out and work on their own project. Then, get up and move around the space and use what they need. That sort of collaborative nature of making appeals. You could do group work here, as that might actually work quite well.

These two examples reflect the shifting mental model of teachers and leadership around what a classroom can look like, and what kinds of activities can take place there.

There are several reasons why specific educational activities may currently be challenging to identify based on constraints identified by teachers in the VR walkthrough. Factors like noise, distraction, and accessibility for all students were connected to classroom management challenges that would need to be overcome to confidently use the space. Accessibility concerns were supported by one participant with expertise in designing learning strategy plans for students requiring accommodations:

> I think it could potentially be overwhelming for some students. I'm envisioning that there's potentially a lot of noise, which is great. However, it may be distracting. Students with difficulty focusing or paying attention may be pulled in so many different ways in this room. Also, there may be students that are anxious about using some of the tools. Additionally, students with fine motor issues may need some support depending on what they're doing, like both in metal shop and wood shop. It can be accommodated. Obviously, safety would have to be first depending on the student's dexterity.

In addition, these types of spaces are relatively new in educational settings. Thus, it is likely that only those teachers with specialized training and experience teaching STEM subjects and design would recognize the potential of the space. All teachers would benefit from training around universal design for learning and the types of specific accommodations required for students with learning strategies and profiles within these spaces, ensuring all students can equally access and benefit from the space's potential.

It is worth noting that students may initially feel intimidated by the unfamiliarity of the space and the complexity of tools and equipment within it. Teachers are also likely to be concerned with student safety and proper operation of equipment and tools. It is also possible that teachers will hesitate to imagine themselves in these spaces until they feel they have acquired the necessary training and support to confidently manage activities in this space. One senior leader expresses solidarity with this view:

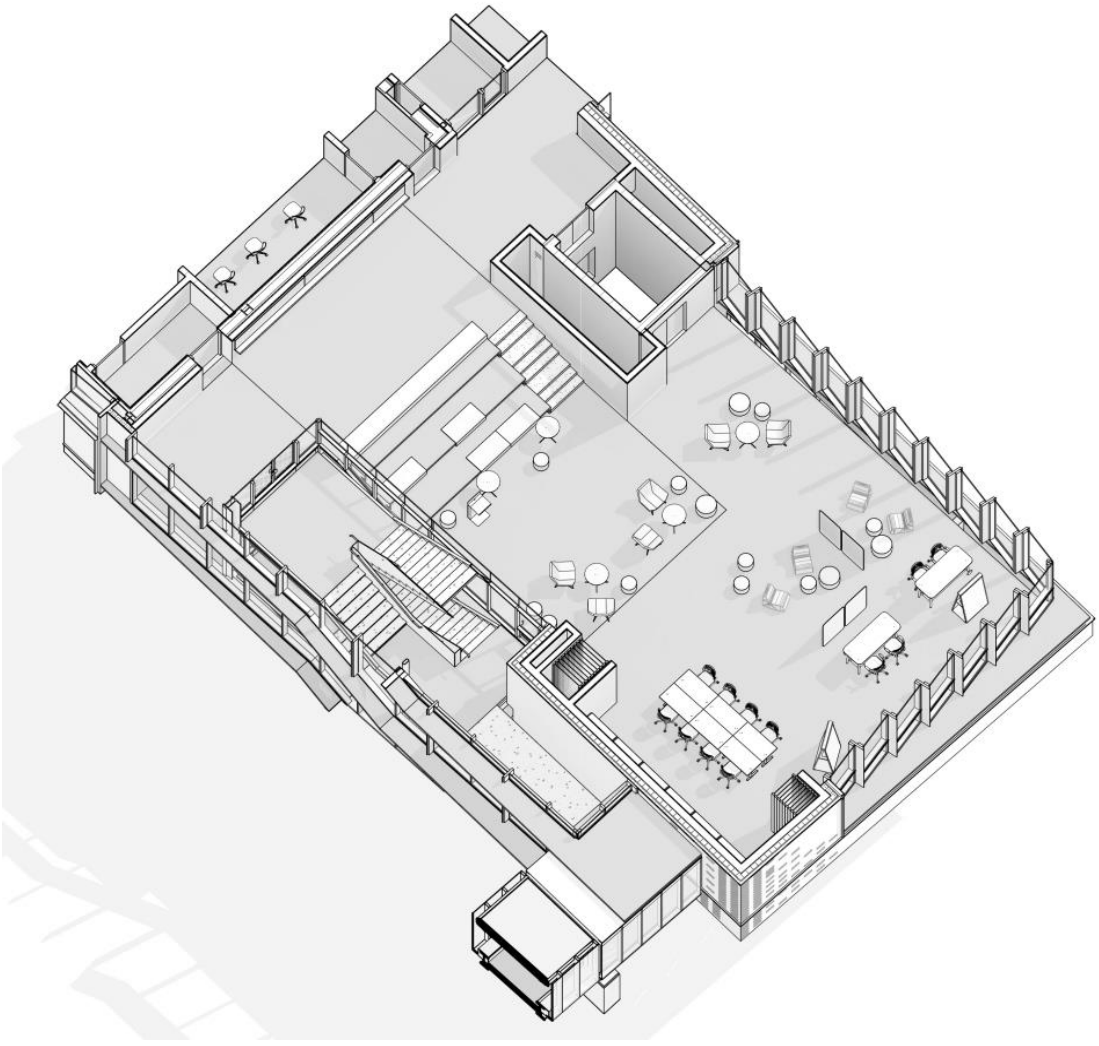
> My fear is around training and getting onboarding to the building. I want to be sure that every user can confidently operate all of the features. Even after the first couple of weeks, we should probably and intentionally build up some onboarding programming.

NOODLE / IDEATION SPACE

The Noodle / Ideation Space is on the second floor of the iCAST. It is characterised by retractable glass walls at right angles, which split the large space into three spaces. These spaces include a Mini-Pitch Space, an Ideation Room and a permanent home for Noodle, Branksome Hall's business accelerator program. This space features a smaller learning staircase, elevator accessibility, mobile furniture, various work surfaces, a "street space," and a glass wall that allows a view of people moving between building levels on the stairs.

Spatial Overview:

Figure 12: Noodle/Ideation Space, Axonometric View



Note: From Ennead & MJMA Architects, 2024, Second Floor Noodle / Ideation Space, Axonometric View. Used with permission.

Figure 13: Participant View of the "Mini-Pitch" Space in Virtual Reality

Note: Screenshot from Branksome 360 Experience, developed by Cicada Design (2023). Used with permission. The image above is a screenshot; the participants had a 360° view.

Figure 14: Participant View of the Second Floor Noodle/Ideation Space in Virtual Reality

Note: Screenshot from Branksome 360 Experience, developed by Cicada Design (2023). Used with permission. The image above is a screenshot; the participants had a 360° view.

Material Affordances

Table 10 illustrates the educational affordances most perceived by participants in the Noodle / Ideation space. This space is characterized by various affordances that meet different needs. Mobile furniture provides quiet work areas or collaboration zones, a multi-use zone caters to individual preferences and activities, writeable surfaces throughout the space encourage brainstorming and social interaction, and a street space fosters a community feel with opportunities for informal learning and gatherings. Finally, the large group area with retractable walls allows for practice space, presentations, collaboration, and mentorship among various group sizes.

Table 10: Material Affordances Perceived by Teachers and School Leaders in the Noodle / Ideation Space

SPATIAL FEATURE	ACTION POSSIBILITY
SMALL SPACE BREAKOUTS	• Small group, individual, and independent work • Spatial separation from other groups
MULTI-USE ZONE	• Caters to individual needs and preferences, providing options for quiet work, group collaboration, and teacher proximity • Students can engage in activities that match their readiness • Comfortable practice space for many disciplines: math problem solving, presentations, arts rehearsals, speech, and debate • Accommodates diversity of ages, encourages interdisciplinary collaboration, and shared learning
WRITEABLE SURFACES	• Whiteboards, writable glass walls, and tabletops encourage brainstorming, visible thinking, group work, ideation, and social interaction
STREET SPACE	• Multifunctional space: informal discussion space, breakout space, independent work, unstructured learning space • Promotes visual connection and sightlines between various learning areas, fostering a sense of community • Social hub and gathering space
LARGE GROUP AREA	• Large gathering space that allows for direct instruction (lectures), presentations, debates, pitches, and performance • Enables larger groups to come together: multiple sections of a course, different age cohorts, and community members • Showcase of learning space • Retractable walls and configuration allow for more than one group at a time and the possibility of various groupings simultaneously: individual, partner, small, and large groups

Large screens and connectivity were touched on less in these second-floor spaces than in the lower-level iCAST spaces. Additionally, positive perceptions of this space as “cozy”, “inviting”, and “filled with natural light” encourage positive reflections from teachers about their feelings towards the space. Research suggests that furniture, aesthetics, and windows have little direct impact on academic achievement. However, they can influence non-achievement behaviours and attitudes of both teachers and students, which may indirectly affect academic outcomes (Martin, 2002).

Again, some SMS teachers in this space started their comments with “what I like…” rather than describing how it would enable current lessons. This unfamiliarity with the environment might explain the difficulty in immediately envisioning how to leverage its affordances to adapt their current lessons. Planning visits to schools with existing innovative learning environments is one way school leadership can support and evolve teachers’ perceptions of how to utilize these space affordances. Regardless, most SMS teachers were inspired by the potential of this space for teaching and learning. They saw it as the most comfortable and accessible space of the three, with comments highlighting its flexibility:

> I like the (retractable) doors for sure. I like how it could be big and open, if needed, and then can be closed off more. I do like all the whiteboard space and the writable space, and I do find it helpful to have somewhere to brainstorm. I like all the different working areas, like there’s the counter at the back, the whiteboards, students can sit on the stairs, and there’s lots of little tables and chairs around so they can break off.

Another teacher echoed this sentiment, emphasizing the space's refreshing departure from traditional classrooms:

> Something like this [getting out of your typical classroom space] could be a bit more inviting. Sometimes you’re a bit “hemmed in” by the space in which you’re always learning. Something like this [space] is a breath of fresh air. And having a different desk, going into different groups, having whiteboards, and whatnot so that you can collaborate and brainstorm...that’s what it feels like you’re supposed to do.

JS teachers typically had more specific ideas around how this space could be used for their current activities, owing to the fact that the JS recently underwent a transformation of their classroom and collaborative spaces in 2018. Most JS teachers are used to teaching in similar environments, perhaps just on a smaller scale. This presents an opportunity for the school to leverage in-house expertise to help guide the adaptation of teaching and learning to the innovative spaces of the iCAST. One JS teacher expressed confidence with open spaces in this way:

> I think, like any kind of open space, the ways that you use it can be multiple, right? You can send students off to find a spot that works for them. With a device, with a notepad, or what have you, can bring them all together again. You can have them sitting on these rows (stairs) and talk to them or have them talk and pitch. There's a lot of flexibility within that space.

One consistently nuanced perception in the dataset was that teachers view iCAST spaces as just a different classroom, focusing on how it can be adapted to existing teaching methods. In contrast, school leadership sees it as a multi-functional learning hub for diverse activities, envisioning it as a transformative learning environment. This perception aligns with the idea that teachers are asking practical questions aligned with praxis and curriculum theory in these initial transition stages. Meanwhile, leadership's perception is future-focused and research-based. One SMS teacher viewed the Noodle/Ideation Space as a direct substitution for a classroom:

> Sometimes we're strapped for a classroom. We have a health room right now. I have a set block and then we rotate through it. There might be two classes in health, and we only have one room. So, we always look for another space, but it would have to fit 20 students. But we could use this space.

Recognizing the space's potential as complementary to traditional classrooms, one SMS teacher, perhaps further along in the innovator's mindset, saw the utility of the Noodle / Ideation Space as being best suited to activities involving larger groups and longer timeframes:

> This space would be more useful for something like those workshops that we did, because students can sit here with their laptops or their notebooks, and we would have whiteboards to write on. So, if we were bringing groups of students together to do some sort of workshop or presentation, I would book this over the Pitch Space. In terms of our lessons, I can't imagine ever bringing them here just for a standard lesson because there's nothing in here that I don't already have in my classroom.

Interestingly, despite low mentions of many of the same affordances—connectivity, large screen, and adjoining spaces, neither leadership nor teachers explicitly discussed the potential for this space to be a low-tech zone. In keeping with an emerging trend of schools adopting technology-free zones to facilitate more face-to-face interaction not mediated by technology, some part of this space could be designated to supporting learning experiences that foster positive face-to-face interactions and a balance to the highly technological functions of the rest of the building (Stebbins, 2023). Certainly, the way the Noodle/Ideation Space was perceived by most participants indicates that it lends itself well to this functionality. Both

teachers and leadership highlighted the comfortable, cozy, and inspiring nature of the space. One SMS teacher envisioned it as:

> ...a really fun space to do creative work. I like all the whiteboards so kids can write on the glass dividers. There's space for students to work independently if they want to, but they can also sit with others. So yeah, definitely for something like creative writing, or even just for reading, and if they want to be doing reading and annotating. It's a big space to spread out to do that.

Leadership described these affordances in a broader context:

> What I like is the fact that we have this connection. And I think we connect the kids to this idea that you're in this innovative space, and we're doing some things that are maybe not traditional types of learning. But we are connected to a historical building. To me, whether the kids consciously realise that or subconsciously, there's a tie to the traditional learning that we will continue to do. It is obviously necessary that it connects to this sort of next generation of learning.

Another leader pointed to the space's potential to inspire:

> I think the learning and teaching are going to feel very healthy. I think this space really reflects healthy spaces, all the natural light coming in, and inspiration from the heritage building. I'm in something new and I'm creating new businesses. I'm innovating new ideas, and I'm looking at the history of a 120-year-old school. So, I think it could be quite an inspirational space that enables creative thought and practices.

The furniture in the Noodle/Ideation Spaces presented a mix of positive and negative affordances to teachers due to both its physical characteristics and fit within Western social norms. Teachers were particularly aware of this duality:

> Strictly from a middle school perspective, some of these furniture pieces might be used in silly ways. I mean, I'm thinking of what currently happens with the middle school lounge furniture. I don't know if they respect it the way that they should. So, I actually worry that this space will be disrespected, and taken advantage of. Because I just feel like I compare this furniture to what we have in the lounges right now. I don't think students use that for its purpose. So, I think a big thing is not just teacher education, but student education. So that they're using these spaces how they're meant to be used and taking advantage of the features.

The need for “rules of engagement’” around the use and configuration of the furniture in the Noodle / Ideation Space offers up the opportunity for students, faculty and the CRC to engage in participatory action research to determine things like what furniture is effective in these spaces, and for what purposes? A process of testing types and configurations with students will ensure an inclusive, adaptable space where students take ownership over the respectful stewardship of the learning environment. This notion of participatory action research is supported in the literature by Woolner et al. (2012), who states:

> Experience demonstrates that change does not always flow through a system and suggests that the nature of the actors’ participation in the process of change is important. It seems likely that a key to enacting sustainable educational change lies in facilitating collaborations and discussions so that changes to space and organization are coupled to changes in teaching and learning practices and based genuinely on the development of shared understandings of all those involved.

Organizational Affordances

Table 10 illustrates the organizational affordances most perceived by participants in the Noodle / Ideation Space. This space provides a flexible learning environment that can accommodate multiple groups, small groups, or individuals. The movable furniture allows for a variety of configurations to support project-based learning, brainstorming, and collaboration for internal class groups and between internal groups and external partners. The welcoming atmosphere encourages exploration, creativity, and non-traditional learning experiences.

Table 11: Organizational Affordances Perceived by Teachers and School Leaders in the Noodle / Ideation Space

SPATIAL FEATURE	ACTION POSSIBILITY
SMALL GROUP	• Small group, individual, or independent work • Spatial separation from other groups
PLACEMENT OF FURNITURE	• Mobile Furniture • Traditional, non-traditional learning space furniture designs (mix of "hard" and "soft") • Many configurations to support a diverse range of activities: brainstorming, individual work, small group or large group, team presentations, and meetings with external partners
TIMETABLING	• Half Day / Full Day (flexible) booking slots
CULTURE	• Partnerships and collaboration with broader school & local community • Time and space to support building capacity, creativity and imagination (e.g., tinkering, brainstorming, dreaming, and imagining) for both students and staff • Mistakes, messes, and noise are a welcome part of learning • Porous educational spaces (e.g., not just a teacher and their immediate students in the space) • Project-based / maker culture • Tinkering and prototyping

Both teachers and leadership perceived high value in the Noodle / Ideation Space for its ability to organize people and groupings. Small group spaces and furniture arrangements were seen as particularly advantageous. Regarding time and space features affordances, the teachers' focus shifts to the importance of flexible scheduling (timetabling), while leadership highlights the space's impact on school culture. Current timetabling assumptions, however—that bookable slots will mirror existing class schedules—pose a challenge. With junior, senior, and middle schools running on different timetables, creative solutions and collaborative planning between teachers and leadership are necessary to define bookable block options. There is also a "cost/benefit" relationship at play—how much value added is viewed as proportional to the length of the block teachers can book. This relationship is particularly true for junior school students and teachers. For example, one JS teacher summed it up this way:

> I can't imagine the younger students coming to use this space because it takes a long time to come over. I can't see them coming to use this because, in many ways, it's similar to a JS classroom. I think if there's the flexibility to do that, (e.g., booking half-day or full-day time blocks) that would be fantastic, especially for the start of project launches where you're thinking about design projects.

> That would make more sense than trying to bring them over for a smaller period of time, especially given that our periods are 40 minutes in the junior school.

This challenge was similarly reflected in one SMS teachers' feelings about the logistics of using the space:

> The challenge is about getting into the space, moving stuff around, getting out the right materials, and then getting out…I'm not going to waste half my class getting there and getting back. So, the challenge is not the space, it's everything else you need to do to use the space.

Organizational affordances linked to school culture are mentioned by both teachers and leadership with more frequent mentions by leadership. A culture of entrepreneurship is elevated here given that the Noodle Accelerator Space is currently planned as the only dedicated space in the iCAST. Many teachers commented on this during the VR walkthrough, most questioning how the Noodle Space might still be able to be leveraged for classroom connections: "Given that the Noodle space is non-bookable, what does that look like in terms of what is available for teachers on this floor? Is that space completely off limits, or can it offer space, materials, and a provocation for learning during class time?"

The vision the Director of Noodle holds for this space has great potential for building connections that extend beyond the school and into the broader community. Being a large, transparent, multi-purpose space, it is likely that new relationships will be forged into classroom practice as a result; holding true to core school values of creativity and building a sense of community that both teachers and leadership perceive in this space. The collaboration of teachers and leadership around how the Noodle Program could be leveraged creatively to transform classroom learning experiences holds great promise.
The Director of Noodle described the promise this way:

> I could imagine [Noodle] companies meeting with a mentor, somebody from industry or someone like the Next 360 program, such as people from MaRS. Just enabling...a space here that we can leverage for these potential partners. I know there was some potential for young alum to have access to these kinds of spaces, if they're starting up something—a little bit of a space to encourage alum to come in and use the space as well. Again, just having that visibility of entrepreneurship in our community is great.

Both teachers and leadership highlighted the value of the space's design for organizing people and activities. Features like small group spaces, adjustable room capacity through movable furniture, and dedicated individual work areas were seen as particularly advantageous. One teacher envisioned using the space for presentations or small group work, including interdisciplinary or transdisciplinary projects:

“I think we would use this space for presentations or small groups. Interdisciplinary or transdisciplinary—you can definitely do team teaching. Working with smaller groups affords you the ability to still kind of see everyone here. I see more potential than I thought.”

A senior leader emphasized the flexibility provided by the movable furniture:

> Depending on the needs, furniture can be easily moved around. So, I think that this space has lots of options. You can have a small group, you can have the common meet and have a bit of an input lesson with a teacher, and you can do presentations. Overall, there are lots of different spaces and you can work by yourself or with a group to collaborate.

Educational Affordances

Table 12 illustrates the educational affordances most perceived by participants in the Noodle / Ideation Space. This space was perceived as a multi-functional learning environment to accommodate both large and small groups. The flexible furniture and adjoining areas allow for easy reconfiguration to support a variety of activities, from brainstorming sessions and workshops to presentations and practice space. Participants viewed this space as one that fosters collaboration and peer learning across disciplines and age groups, making it ideal for project-based learning and independent study.

Table 12: Organizational Affordances Perceived by Teachers and School Leaders in the Noodle / Ideation Space

SPATIAL FEATURE	ACTION POSSIBILITY
FLEXIBLE / ADAPTABLE LEARNING SPACES LARGE GROUP SMALL GROUP ADJOINING AREAS	• Brainstorming • Ideating • Problem-solving • Presentations • Workshops • Practice space • Group discussion • Group collaboration • Cross-subject and age cohort interdisciplinary projects
PLACEMENT OF FURNITURE	• Group discussion • Group collaboration • Peer learning
STREET SPACE	• Homework and study • Peer learning

While overall the Noodle / Ideation Space looks very different from the traditional classroom, it incorporates elements familiar enough to align with educators' current understanding of learning environments. Teachers readily identified familiar features like whiteboards and tables as affordances for brainstorming, group work, and presentations. One SMS teacher commented, "This is pretty nice for collaborative work and for having students decide how they're comfortable working and where they'd like to work." They elaborated on the space's versatility: "I like that there's this sort of separate whiteboard room and little discussion tables. Sometimes I'm having half the class do a debate, while half the class does something else. This is a nice space for that. Instead of just kicking them out into the hallway!"

An SMS science teacher saw an additional benefit in the proximity to other iCAST spaces and resources that would facilitate a seamless "project flow" throughout the building.

> In science, we have a group 4 interdisciplinary project. So, this would be a space that we could use for bringing the entire Grade 11 cohort together. Then we can discuss this project and have the ability to break off into different spaces. If they had a project that involved anything in the machine shop, they would be close to that. Perhaps we can encourage that as part of the project in the coming years.

These comments highlight how the Noodle / Ideation Space, in addition to its innovative design, offers affordances that resonate with educators' existing practices while also providing dedicated areas for activities that were previously relegated to less ideal locations within the school. This balance between familiar elements and new possibilities contributes to the space's perceived effectiveness as a learning environment.

The Noodle/Ideation Space breaks away from traditional classrooms and the more technology-rich spaces of the iCAST's lower level, showcasing a less formal atmosphere that prioritizes interactive and collaborative learning. While this shift means the space might not be ideal for activities like lectures or robotics, its informality unlocks affordances associated with the themes of nurture and school values. Abundant natural light and proximity to greenery create a comfortable, casual setting that stimulates open-ended thinking and idea generation. The open layout also encourages collaboration and interaction, making it ideal for both internal and external community collaborations. Diverse seating options empower students to choose their preferred learning arrangement, fostering a more personalized learning experience. One senior leader perceived the space this way:

> I think you've got lots of small group collaboration and individual workspaces here, which allows the teacher to just circulate between the learners. And they can choose their preferred modality to be on the ground, grab a seat at the desk, or sit in some comfortable soft seating. If you want some practice presentations, you've got that nice space here with the seats. It'll just be an acoustics challenge.

Given that students in the SMS are relatively new to the idea of "preferred learning arrangements," I wonder about they'll understand or know to choose one? Have they been introduced to possibilities? What does research say about which learning arrangements are beneficial and for whom? Some students may find certain setups are not beneficial to their learning, even though they might prefer them. These relevant questions situate us squarely at the threshold of the "learning frontier" when understanding the intended affordances and the teacher's universal design for learning (UDL) lens.

ADDITIONAL AFFORDANCES

In addition to the themes identified through the TEALE model, the data revealed two further empirically generated themes: nurturing affordances and values-based affordances. These themes, shown in Table 13, encompass nine additional affordances that characterized participants' perceptions of the iCAST spaces during the VR walkthroughs. Notably, these themes were applicable across all the spaces, functioning as the "connective tissue" that binds the iCAST building together.

Table 13: Additional Empirically Generated Themes/Affordances, Specific to Branksome Hall

SPATIAL FEATURE	ACTION POSSIBILITY
WELCOMING ENVIRONMENT	• Supports goals of DEI, SEL, and LSPs • Reduces anxiety • Increased motivation to engage in new approaches to learning • Builds a sense of community and collaboration
LESS FORMAL ATMOSPHERE THAN CLASSROOM	• Lighting and soft architecture features provide comfort and a feeling of coziness • Flexible configurations encourage movement and collaboration • Student-centred learning puts focus on building student agency • Safe space for experimentation and making mistakes without judgement • Development of informal relationships that foster a positive educational environment
ELEVATED "AIR" OF PROFESSIONALISM	• Builds confidence • Preparation for future academic and professional contexts in a "real-world setting" • Improves student focus and attention
NATURAL LIGHT	• Biophilic design enhances mood and energy levels, promoting improved focus and attention, and improving performance on critical thinking and information processing tasks (Scott, 2020) • Reduced instances of eye strain and stress when compared with artificially lit conditions, promoting an overall sense of wellbeing (Shishegar & Boubekri, 2016)
VISIBLE NATURAL (GREEN) SPACE	• Viewing nature, even through windows, positively impacts the parasympathetic nervous system, increasing cognitive function, improving attention, and enhancing feelings of calm and wellbeing (Abkar et al., 2010) • Contributes to a more positive classroom climate, encouraging respectful interactions during deep collaborative work tasks (DeLauer et al., 2022) • Facilitates cognitive restoration, enabling fresh perspectives and renewed energy for creative problem-solving (Robbins, 2020)
CHANGE OF ENVIRONMENT	• Break the monotony of routine space to spark excitement and elevated engagement when unveiling new projects • Changing up the learning environment allows teachers to cater to diverse learning styles, keeping all students engaged and motivated

	• Switching environments allows students to utilize the affordances of new spaces to tackle different aspects of problem-solving challenges with fresh perspectives
CO-DESIGNED SPATIAL RULES OF ENGAGEMENT	• Contributes to the school's values of community and inclusiveness by instilling a sense of ownership and investment in the learning environment amongst all community members—leading to increased responsibility for maintaining the space and fostering a sense of pride
ONGOING ONBOARDING	• Continuous onboarding, providing opportunities for learning, interaction, and relationship building fosters the school's values of community and inclusivity among all community members (new and current) • A dynamic, evolving process over time contributes to the school value of making a difference, fostering a culture of shared knowledge and collaborative practice over time that evolves as necessary to remain relevant and valuable for all community members
ENVISIONING THE FUTURE	• Envisioning the future taps into the school's values of creativity and making a difference • Opportunities for creative thinking and expression spark curiosity and encourage students to think beyond their immediate surroundings and consider the impact of their actions in local contexts and beyond

5.0 DEVELOP

5.1 TEACHER WORKSHOP

This section responds to the research questions:

- What spatial qualities enable and/or constrain the principle aims of the iCAST building?
- How might we recognize the potential of space as a pedagogical tool to achieve the principle aims of the iCAST building?

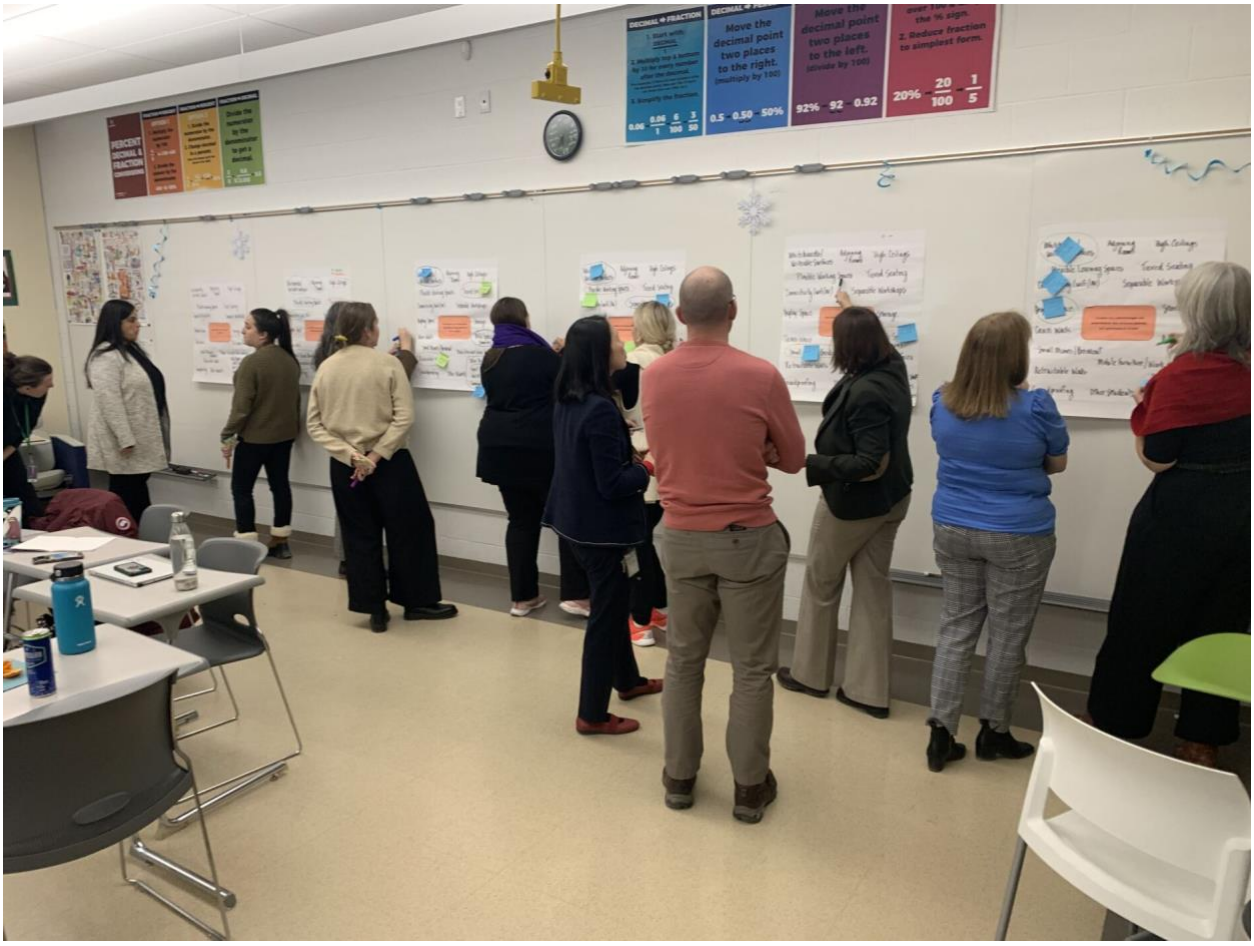
On January 17th, 2024, thirteen of the seventeen participating teachers attended a post-walkthrough workshop. This session focused on how the perceived spatial features, identified during the VR walkthrough, aligned with or constrained the iCAST's intended aims/goals (as outlined in Table 14).

Table 14: iCAST Aims and Perceived Spatial Qualities

iCAST Aims (2018)	PERCEIVED SPATIAL FEATURES (EMERGENT FROM VR WALKTHROUGHS)
Societal and cultural images, and environments that promote diversity and opportunity in STEAM	• Whiteboards or writable surfaces • Adjoining rooms • High ceilings • Flexible working spaces • Tiered seating • Connectivity (wifi and AV) • Retractable walls • Pitch Space or Commons • Storage • Glass walls • Display space • Separable workshops • Mobile furniture and worksurfaces • Soundproofing • Other students • Other people: expert support staff, guest speakers, and community members • Small alcoves and breakout spaces
Innovative and accessible measures of learning	
Flexible and inclusive learning spaces supported by innovative technologies	
Interdisciplinary and transdisciplinary approaches to solving "grand" and "micro" challenges	
Accessible learning activities that invite intentional play and risk-taking	
Engaged and networked communities of practice	

Figure 15 shows participants in the teacher workshop divided into groups, engaged in discussions, and drawing connections between the spatial qualities and the aims of the iCAST.

Figure 15: Teacher Workshop



Note: Participants engaged in drawing connections between spatial qualities that enable and constrain the aims of the iCAST.

When the workshop activity began, the first thing that became apparent was that many participants (five out of six groups) had questions about how to interpret the aims of the iCAST that were presented. One participant began: “I have to first ask...what does the first part of that really mean?” and another: “When we’re talking about communities of practice, what does that mean? Does it just mean a group? Does it mean outside external people? Other participants raised questions about the aims, such as: “Do all of the aims need to be related explicitly to academic learning? The iCAST could be leveraged to build community by providing social spaces for unstructured socialization and community time.” Other participant asked: “Were the aims co-constructed with teachers?” The aims were written up in 2018 in

a future visioning document by a member of the senior leadership team who no longer works at the school. It has been my understanding that these aims were not set in stone and that the opportunity exists to re-visit and co-construct these aims. Involving teachers in this aspect of the design process seems particularly important from the perspective of assuring ownership and effective use of the space.

In a paper on "Building Schools for the Future Through Participatory Design" Woolner (2009) suggests the importance of giving teachers a specific role in the design process without which they:

> Do not feel that their professional knowledge of the school, or education more generally, is being valued. As well as contributing to their perceived lack of excitement, this also undermines the goal of making links between current practice, the teachers' ongoing experience, and the future classroom environment. It seems necessary that the role given to teachers during a school design process is explicitly related to their knowledge of school life, and genuinely values their potential to embed the new environment within continuing and developing practice.

This sentiment is echoed in a study on the processes used to transform traditional classrooms into flexible learning spaces by Kariippanon (2019), who found that "Consultation with teachers and among teachers was vital to the success of flexible learning spaces, given their significant vested interest" (p. 581). However, when considering the logistics of teachers' participatory role during the design process, Konings (2017) found that despite the best intentions to include teachers either directly or indirectly during the design process, it was difficult due to budgets, tight deadlines, and teachers' workloads.

Participants were instructed to interpret the iCAST aims to the best of their ability and to complete the activity based on their interpretations. Feedback, thoughts, and questions about the aims were collected on chart paper.

Among the six iCAST aims, the spatial features most perceived as enabling the aims of the iCAST were:

- Other people
- Small alcoves and breakout spaces
- Whiteboards and writable surfaces
- Mobile furniture and worksurfaces
- Large spaces
- Connectivity

Those features most cited included material affordances that were easily perceived as enabling aims of diversity and opportunity in STEM, inclusive learning spaces, interdisciplinary and transdisciplinary

approaches, and accessible learning activities. This outcome can be attributed to a couple of factors. To begin, the PYP program in the JS is entirely based on a transdisciplinary approach. It has been leveraging these material affordances with a strong understanding of how they can be used to differentiate and personalize the student experience for several years. One JS teacher demonstrated a level of comfort in an adaptable environment by stating: “Learning doesn’t need to look the same every day, and it can shift and change depending on the needs of the students.” In addition, diversity, equity, and inclusion are embedded in curriculum practices from JK-12 and is part of the school’s strategic plan.

The prevalence of whiteboards in the iCAST resonated with most participants. They perceived this familiar material affordance as a tool that aligns with the aims of using diverse teaching approaches, particularly in interdisciplinary and project-based learning. As one educator noted, “The fact that you can write on lots of things promotes a lot of opportunity for UDL (Universal Design for Learning)—this is also another way of thinking about diversity and opportunity.”

Some educators, however, expressed concerns about some of the space’s overall novelty. The abundance of whiteboards, while valuable for visual learners and project-based work, led some to question how different the space truly is from existing classrooms. One educator stated, “...the whiteboards and writable surfaces...they’re flexible, because it allows for brainstorming, group work, and collaboration. Right now, we’re having difficulty seeing how this is different from what we already have in classrooms.”

This sentiment highlights the need to provide familiar tools like whiteboards and leverage other unique design affordances of the iCAST spaces supported by professional learning to create a truly innovative learning experience.

Many participants saw a strong connection between the organizational and material affordances of “other people” and “connectivity,” and their potential to achieve the aims of promoting diversity and opportunity in STEAM education, innovative learning assessments, accessible learning activities, and fostering networked communities of practice. One teacher queried:

> When we think about promoting diversity and opportunity, how do we connect with the broader society? How do we bring the broader society in different ways—the idea of other people being live and whether they work there or are guests. Also, the fact that there’s this connectivity and the outside world becomes porous in terms of access.

Experts, guests, and connectivity were seen as a way to facilitate innovative assessments, as one SMS teacher noted: “Having expert support staff, guest speakers, and community members, (in-house) might

potentially provide inspiration for alternate assessments using some of these spaces ...even having the opportunity for not assessing with a mark but providing feedback."

Finally, the flexible nature of the environment and ability to break off into semi-private groups was seen as a draw for leveraging guest and expert knowledge. Those spatial features that were perceived to be associated with both positive and negative affordances, were those that were less available in traditional educational spaces. Thus, those with which teachers have less experience.

Features, such as mobile furniture and flexible workspaces, presented opportunities for inclusivity through adaptation. However, as one educator noted, "If the furniture gets left kind of haphazard all the time that can also be very distracting and could take away from the learning."

Similarly, the flexibility of some iCAST spaces sparked concerns about potential misuse. One educator questioned: "Yes, (spaces are) flexible, but because they're flexible, can anyone use them? If anyone can use them for anything, and they're just having social time versus working, is that impacting learning?" These concerns highlight the need for clear rules of engagement and expectations around space usage. Kariippanon (2019) found that one way to improve student stewardship of flexible spaces was to engage students in the soft architecture needs of the learning spaces. This study showed that in secondary schools, a sense of ownership and acceptance of the space through student engagement translated into a "marked decrease in vandalism of furniture items which was sustained over time" (p. 583).

5.2 SPATIAL PROFILES:

Data from VR walkthroughs of three spaces—The Pitch Space, Robotics/Design Space, and the Noodle/ Ideation Space—was analyzed to create spatial profiles. These profiles capture how teachers and school leaders currently perceive the affordances of each space for teaching and learning, both now and in the future. Each profile is intended to be a dynamic resource for teachers transitioning to the iCAST, each offering an overview of possibilities, empowering teachers to explore the impact of space on pedagogy and inspiring the development of innovative practices. This profile analysis directly aligns with the school's strategic goal of fostering "...continuous adaptation of learning in a changing world," and supporting "...the requirements and expectations of a 21st'century education" (East Campus Renewal Study, 2018).

The focus on affordances provides a foundation for teachers. It allows them to envision possibilities within their own context and collaboratively with colleagues. Additionally, these profiles offer guidance in selecting spaces that best suit their curriculum goals. This guidance empowers teachers to make informed decisions about space use—a significant shift from traditional classrooms where such choices were often predetermined.

PITCH SPACE

Table 15: Pitch Space Affordance-Based Spatial Profile

PITCH SPACE AFFORDANCES

SPATIAL FEATURE	ACTION POSSIBILITIES
LARGE GROUP AREA	• Provides space to showcase student projects and demonstrations, including tech demos, impromptu displays of work from makerspaces or Robotics Labs, or sharing interesting works in progress with other students or visitors • Incorporates display areas or interactive stations to encourage engagement and curiosity
LEARNING STAIRCASE	• Elevated sense of audience role feels more welcoming, comfortable, and engaging • Enables all students (regardless of size) to see and participate equitably
ROBOTICS ARENA	• Retracting the glass wall allows for the Pitch Space to transform into an important adjoining space for the Robotics Space and facilitates project flow and collaboration • The Pitch Space can become an amphitheatre for robotics performances and demos • The front of the Pitch Space provides ample floor space for testing robots • Planked seating allows for small groupings and an iterative workspace
SMALL ALCOVE SPACES	• Breakout spaces within the pitch area provide opportunities for students to collaborate in smaller groups • The two alcoves and lobby area are spaces where students can gather to refine their work, practice skills, and provide feedback to one another • Small alcoves provide a space for teachers to work 1:1 with students requiring personalized support or private conversations
LARGE GROUP CAPACITY	• Allows for multi-modal learning for presentations, performances, lectures, discussions, and debates • Enables larger groups to come together; multiple sections of a course, different age cohorts, and internal/external community members
AUDIENCE	• Opportunity for practice, feedback, and assessment • Active participation and exchange of ideas between the audience and presenters, and between audience members • Sharing of skills and knowledge with various audiences (students, staff, and community members) through critique, feedback, interactive presentations, and participatory arts productions
RETRACTABLE WALLS	• Adjustable room capacity • Acoustic separation • Ability to connect or separate spaces • Supports team teaching
TIMETABLING	• Intentional scheduling of inter/transdisciplinary activities between different classes and grade levels • Provision of inter/transdisciplinary planning time

SMALL, ALCOVE SPACES	• Peer learning/assessment • Semi-private space for presentation preparation
LARGE GROUP AREA	• Direct instruction (lecture) • Group discussion • Group collaboration • Presentation • Workshop • Performance • Pitch • Guest speakers • Peer learning • Pop-up performances, pitches, and tech demos
LEARNING STAIRCASE	• Large size of the space makes it suitable for presentations and performances • Allows embodied learning through active, dynamic conversations • Teachers can incorporate direct instruction, student-led presentations, debate, and reflective activities in this area • ATL skill development: effective presentation techniques, public speaking skills, and active listening
SPATIAL OPENNESS OR HIGH CEILING	• Experiments requiring a controlled environment or high ceiling

ROBOTICS/DESIGN SPACE

Table 16: Robotics / Design Space Affordance-Based Spatial Profile

ROBOTICS SPACE AFFORDANCES

SPATIAL FEATURE	ACTION POSSIBILITIES
SEPARABLE WORKSHOP SPACES (WOOD OR METAL)	• Dedicated areas for focused work • Manufacturing process work without noise, dust, and disruption to other spaces
MULTIPLE SURFACES TO WORK ON	• Group collaboration • Project assembly and testing • Independent work • Differentiation and personalization of process work
ADJOINING SPACES	• Adaptable space capacity • Movement, interaction, and observation among students and teachers • Close proximity of pitch, robotics and design, and specialized workshops ensure student projects benefit from an easy transition between each phase of the design cycle
SMALL GROUP	• Small group, individual, and independent work • Spatial separation from other groups
RETRACTABLE WALLS	• Ability to manage larger groups • Supports team teaching • Acoustic separation • Ability to connect or separate spaces
SUPPORT STAFF	• Support team teaching and collaborative approaches to planning
CULTURE	• Partnerships between teachers and expert support staff • Time and space to support building capacity, creativity, and imagination (tinkering) for both students and staff • Mistakes, messes, and noise are a welcome part of learning • Porous educational spaces (not just teachers and their immediate students in the space) • Project-based and maker culture
LARGE, OPEN DESIGN / MAKERSPACE	• Group collaboration • Group discussion • Project-based learning • Movement and agency in students who can easily access tools and materials • Flexibility to sit, stand, and work individually or in a group • Build, model, and make
ADAPTABLE SPACE	• Brainstorm • Ideation • Problem solving

	• Peer learning • Team teaching • Student choice in how they are comfortable working and where they would like to work • Differentiated instruction: students work wherever they are • Teachers play to their strengths • Space to move around for more active learning pedagogies
EXPERT SUPPORT STAFF	• Can deliver presentations and workshops • Allows for higher-level (more complex) projects supported in a safe environment • Contribute expertise for learning and capacity building of students, faculty, and staff • Fosters real-world applications • Support team teaching and collaborative approaches to planning

NOODLE / IDEATION SPACE

Table 17: Noodle / Ideation Space Affordance-Based Spatial Profile

NOODLE/IDEATION SPACE AFFORDANCES

SPATIAL FEATURE	ACTION POSSIBILITIES
SMALL SPACE BREAKOUTS	• Small group, individual, and independent work • Spatial separation from other groups
MULTI-USE ZONE	• Caters to individual needs and preferences—by providing options for quiet work, group collaboration, and teacher proximity, students can engage in activities that match their readiness • Comfortable practice space for many disciplines: math problem solving, presentations, arts rehearsals, speech, and debate • Accommodates diversity of ages, encourages inter/transdisciplinary collaboration, and shared learning
WRITEABLE SURFACES	• Whiteboards, writable glass walls, and tabletops encourage brainstorming, visible thinking, group work, ideation, and social interaction
STREET SPACE	• Multifunctional space: informal discussion space, breakout space, independent work, and unstructured learning space • Promotes visual connection and sightlines between various learning areas, fostering a sense of community • Social hub and gathering space
LARGE GROUP AREA	• Large gathering space that allows for direct instruction, presentations, debates, pitches, and performance • Enables larger groups to come together: multiple sections of a course, different age cohorts, and community members • Showcase of learning space • Retractable walls and flexible configuration allow for more than one group at a time and the possibility of various groupings simultaneously: individual, partner, and small and large groups
SMALL GROUP	• Small group, individual, and independent work • Spatial separation from other groups
PLACEMENT OF FURNITURE	• Mobile furniture • Traditional and non-traditional learning space furniture designs (mix of “hard” and “soft”) • Many possible configurations to support a diverse range of activities: brainstorming, individual work, small group or large group, team presentations, and meetings with external partners
TIMETABLING	• Half day and full day (flexible) booking slots
CULTURE	• Partnerships and collaboration with broader school and local community • Porous educational spaces (not just teacher and their immediate students in the space) • Entrepreneurial culture

FLEXIBLE AND ADAPTABLE LEARNING SPACES: LARGE GROUP, SMALL GROUP, AND ADJOINING AREAS	• Brainstorming • Ideating • Problem-solving • Presentations • Workshops • Practice space • Group discussion • Group collaboration • Pitch • Cross-subject or age cohort interdisciplinary projects
PLACEMENT OF FURNITURE	• Group discussion • Group collaboration • Peer learning • Conference with external partners
STREET SPACE	• Homework and study • Peer learning

6.0 DESIGN

6.1 RECOMMENDATIONS

Through developing insights from VR walkthroughs, issues identified by participants as activation constraints, the teacher workshop, and secondary research, I have identified five key practice implications for Branksome Hall's next steps. These recommendations align with the early transition phase identified by the Innovative Learning Environments and Teacher Change (ILETC) project and build upon the affordance approach explored here. The ILETC project is an Australian Research Council Linkage Project launched in 2016 that convened leading researchers in educational learning environments with partner organizations specializing in learning environment design and technology (ILETC, n.d.). One of the project's major outputs was the Spatial Transition Pathway, which was designed as a resource offering temporally aligned strategies and tools for schools navigating similar transitions. The possibility exists to contribute our strategies to this pathway as we transition to the iCAST, which would expand our learning network and enrich the resource. As a school committed to partnering with others in areas that complement the CRC's research priorities and advance the future of education (Branksome Hall, n.d.), I recommend the school explore this possibility.

CROSS-TEAM COLLABORATION

One of the insights generated through the VR walkthrough was the value of cross-team collaboration, or "harmony in the huddle." Given the immediate material and organizational affordance needs perceived by teachers and the future-forward strategy and research vision applied by leadership, I recommend that cross-team collaboration be a focus when considering all practice implications to ensure a successful and sustainable transition to the iCAST and to nurture the bonds of collegiality.

REVISIT ICAST AIMS

During the teacher workshop, the participants found it difficult to connect with the aims of the iCAST. Teachers clarified this challenge when they characterized their comments about their connection to spatial features. One teacher asked: "Are the stated aims going to be updated to reflect teaching and learning in a post-pandemic world?" Thus, several factors necessitate revisiting the iCAST goals through a participatory lens:

- The learning principles, drafted in 2018, predate changes in teaching and learning brought about by the COVID-19 pandemic.

- Many personnel involved in the initial design phases have since left the school, impacting continuity.
- Project delays caused by the pandemic resulted in cost overruns, which led to the removal of features from the original design, creating a space different from the initial vision.

Research strongly supports the role of participatory design in fostering a sense of ownership and investment in a space (Osborne, 2020; Könings et al., 2005; Bøjer, 2021; Morris & Imms, 2022; Woolner et al., 2012). Revisiting the iCAST goals through this lens would promote educators' feelings of connection to the space and its purpose.

A participatory process could be further enriched by considering future users of the space. For instance, who might be a part of our future school community? Incorporating the school's core value of community suggests including stakeholders beyond its immediate walls. While including community partners in goal setting might seem unconventional, Woolner (2009) argues: "Even where the nature of the person's role makes their area of expertise reasonably predictable, their actual understanding can be wider or more nuanced than might be expected" (p. 12).

FUTURES WORKSHOPS

"Any useful statement about the future should at first seem ridiculous." This statement, made by renowned futurist Jim Dator alludes to the potential for futures thinking to take us to a place that present thinking cannot. It grants permission to break the orthodoxies and conventions that often restrict us from pushing our thinking into new places where new futures can be imagined (Forchheimer, 2022). Indeed, it was difficult for many participants to envision themselves and their practice in the iCAST. Traditional classrooms, curriculum standards, and school norms have had a hold on the educator mindset since the Industrial Revolution when the goal of education was to teach future factory workers to be "punctual, docile, and sober" (Schrager, 2018). There is a culture of compliance long embedded into the perception of school—what it looks like, where it happens, the role of a teacher, and even who can be a teacher. Likewise, local, national, and international curriculum standards must be met to maintain accreditation as a school.

Education has long felt stuck between tradition and innovation, a consequence of deeply ingrained Western ways of being, knowing, and doing. The iCAST disrupts this inertia. It embodies the potential for a more pluralistic approach to education, one that celebrates diverse ways of being, knowing, and doing. It serves as a tangible prompt to challenge our assumptions about schools and to embrace a design approach that fosters collective conversations about the future of education. Design theorists Anthony Dunne and Fiona Raby describe this approach as "speculative design." Foresight, futures thinking, and speculative design are complementary practices that act as catalysts for redefining our

relationship with reality. They encourage us to explore “what if” scenarios and imagine alternative ways of being (Escobar, 2018). As Dunne and Raby argue, design speculations challenge the status quo and prevent us from replicating traditional models (Escobar, 2018). Therefore, a series of futures workshops are recommended here.

While futures cannot be predicted, Dator argues that alternative futures can, and should be forecast (Dator, 2019). A variety of foresighting techniques can be employed to forecast desired futures. The goal is to establish a shared understanding of the forces shaping the future to aid decision-making. The utility of applying foresight in the design process at this post-industrial juncture is unmistakable. As Stein (2009) offers, (foresight) “guides the shape, function, and possible use of an object, system, or place.” Foresighting techniques allow for stakeholders to come together in a convivial way, drawing on imagination, creativity, and collaboration. Branksome Hall has a unique opportunity to reimagine the future of school through a series of futures workshops recommended as much for their value in creating community as their strategic, operational value. It is particularly powerful when considering design theorist Anne Marie Willis’ (2006) premise of ontological design: We design our world, but our world also shapes us in return.

DEVELOP TEACHER SPATIAL LITERACY

Research has established that developing environmental competence and understanding how to effectively organize instructional space is critical to successful classroom practice, both in terms of classroom design (Lackney, 2008 as cited in Taylor 2005; Sanoff 2001; Nelson & Sundt 1993; Taylor & Vlastos, 1983) and management (Lackney, 2008 as cited in Weinstein 1996; Follows, 2000). When teachers lack this competence, it impedes their ability to capitalize on the affordances of the physical learning environment for pedagogical benefit and ultimately improved academic outcomes (Kariippanon, 2020). The development of “spatial literacy” (Nelson & Johnson, 2021 as cited in Imms, Cleveland, & Fisher, 2016, p. 6) required to enact teaching and learning in ILEs adds a “significant layer of complexity” (Nelson & Johnson, 2021 as cited in Fletcher, Mackey, & Fickel, 2017, p. 71) in the transition to ILEs for teachers. Leighton (2017) as cited in Imms and Mahat (2021) argues that spatial competence constitutes a form of literacy and thus, requires nurturing. Significant capacity building is recommended in this area for experienced teachers, as training in pre-service education programs is only at an early stage of development. Pre-service teacher education programs in New Zealand have begun to develop spatial literacy in teacher candidates. In a study on socio-spatial challenges of ILEs for practicums, Nelson and Johnson (2021) found that pre-service teachers cited “steep and novel challenges around how they plan, teach, assess, manage students and learning, as well as work collaboratively with associate teachers and, increasingly, other colleagues during their ILE practicum experiences” (p. 291). This insight is helpful in targeting areas of training in spatial literacy and environmental competence.

Three approaches are recommended for developing teachers' spatial literacy at Branksome Hall:

APPROACH 1: Peer Learning and Observation

Branksome Hall's Junior and Middle Schools conducted an ILE pilot project that was documented by the school's in-house Chandaria Research Centre (CRC) in 2018. Though the focus of these studies was on classroom configurations, which are different from the larger, open spaces of the iCAST, the findings of these studies can be valuable in identifying the teacher experience of transitioning to more adaptable ILE spaces. In addition, the opportunity for teachers within the same school to be able to participate in classroom observations and shared learning is recommended.

APPROACH 2: Field Trips and Analogous Spaces

The 2018 "Branksome Hall Innovation Centre Vision for the Future" report documents several local schools in the Competitive Scan and Analysis. It is recommended that we leverage our relationships with these local schools or others further afield to send teachers for "job alike" discussions and observations. In addition, analogous spaces like museums and art galleries offer inquiry-based educational programming that encourages similar approaches to ILEs: exploration, collaboration, and independent learning in large, open, and fluid spaces. While the museum experience traditionally has privileged a Eurocentric-colonial concept of the body-mind binary, many are moving towards what Columbia University Doctoral Student (Art Education) Filippa Christofalou (2022) calls a "body-based pedagogy." It contributes to decolonial praxis in Museum education spaces; one that supports more body-mind-spirit encounters in educational spaces. Given the alignment of Branksome Hall's DEI priorities and the need to develop spatial capacity in teachers, professional development that includes learning in analogous spaces is recommended.

APPROACH 3: Development of Visual and Spatial Cues

Research points to visual and spatial cues being powerful spatial management tools (Saltmarsh et al., 2015). A visual language system can effectively communicate expectations for resource use, activity setup, and expected behaviours, minimizing the need for repetitive instructions. These cues can be strategically developed by students, teachers, and school leaders based on the affordance-based spatial profiles created in this project. Such a project might even be undertaken as a graphic design unit in one of the school's Design courses.

Branksome Hall's Faculty Growth Program

This in-house professional growth program empowers educators to design inquiries into their teaching practices that align with the school's strategic goals. It fosters the development of both educators' skills and the students' classroom experiences (Branksome Hall 2023-2024 Strategy Report, 2024). The

program can be leveraged as a vehicle for onboarding new teachers and equipping experienced educators with the skills to develop spatial literacy.

PROFESSIONAL LEARNING

One of the five persistent principles of change identified in Osborne's (2020) study on change leadership when implementing ILEs was: "Change is more sustainable when it occurs in smaller, incremental steps rather than in large seismic steps" (as cited in Waters, Marzano, & McNulty, 2003, p. 8). The ILETC's spatial transition pathway acknowledges the need for time in the early transition stage where teachers develop knowledge about the iCAST and conceptualize how they should use it (Imms & Mahat, 2022). This transition includes professional learning in areas beyond spatial literacy described above.

One of the things participants in this study described being most excited about regarding teaching and learning in the iCAST is the ability for more collaborative work: team teaching, interdisciplinary projects, and cross and full-grade opportunities. One teacher characterized her expectations of the space this way:

> It lets teachers play to their own strengths in terms of like, if you wanted, a lecture-style lesson. Somebody can be lecturing on something that they are more passionate about or know more about to everybody all at once. Then, they can go back into almost a tutorial-like setting. It's not shockingly innovative, but it's something that we can't do right now in our space. I think that enables more collaboration between teaching teams and collaboration between students in different sections.

This assumption of professional collaboration in ILEs was noted by Bradbeer (2022) who cautioned that despite schools historically encouraging a collaborative practice between teachers, traditional classroom settings have typically constrained this possibility, leaving teachers interested in the approach. Yet, they have a limited practical understanding of the skills required to successfully "teach, work, and be together" (as cited in Imms & Mahat, 2022, p. 29).

The transition to teaching in the iCAST will require significant adjustments for educators. To support them in this shift, it is recommended that professional development be initiated during the early-stage transition phase. The benefits of beginning professional development at this early stage are threefold: It will encourage a culture of growth and experimentation, reflect the importance of supporting change, and equip educators with opportunities to experiment and iterate on practical approaches to building capacity for collaborative practices. Three key areas for early-stage professional learning that build collaborative muscle are outlined in Table 17.

Table 18: Areas for Professional Learning in Collaborative Capacity Building

	CAPACITY REQUIRED	**PROFESSIONAL DEVELOPMENT OPPORTUNITIES**
SCALING OF PRACTICE TO LARGER GROUPS	• Team teaching • Co-teaching	• Workshops to support teachers in understanding affordances of each space in the iCAST and how they can support the possibilities of space for scaling their practice • Workshops, seminars, courses, and training on approaches to team teaching and co-teaching • Field trips to observe team teaching or co-teaching approaches at other schools • Professional coaching and mentoring • Prototype and trial ideas in available spaces
RE-THINKING ORGANIZATIONAL AFFORDANCES (TIME AND SPACE)	• Scheduling that allows for different groupings of students, courses, teachers, and time blocks • Competence with technological affordances of iCAST	• Workshops and training on approaches to organizational and technological affordances • Job-alike mentoring from network and other schools
DEVELOPING EFFECTIVE SKILLS	• Visible and public teaching practice • Collaborative mindset • Adaptability • Empathy and understanding of personal boundaries • Resilience	• Cross-departmental team building exercises • Prototype and test lessons in current open spaces, such as the library • Professional coaching and workshops delivered by in-house Centre for Strategic Leadership (CSL) • Faculty Growth Model support

*Note: A*dapted from Bradbeer (2022) as cited in Imms & Mahat, 2022.

In addition to professional development in the area of collaboration, the ILETC project highlighted a need to support teachers in understanding the technologies available in ILE spaces and how they enhance student learning (Mahat et al., 2017). It is recommended that a process of familiarization with the technology available in the iCAST begin as soon as possible: training on applications, tools and machines, and practice within prototyped spaces will all serve to build teachers' technological capacity.

7.0 CONCLUSION

I began this project with a similar belief to Mahat et al. (2020), that significant “design strategies and tools” would be needed to support teachers in their transition to the iCAST. I am a teacher of 25 years, with my experience firmly rooted in a Western approach to curriculum. My curiosity about “how” will we teach led me to ask a deeper question:” How might we leverage the perception of affordances to support the activation of space as a pedagogic tool? My initial research led me to view the development of an affordance acumen among teachers as a first step in the transition to these more ephemeral learning spaces.

To develop this acumen, it was first necessary to explore the questions: What are innovative learning environment affordances? How are the affordances of the iCAST perceived by school leaders and teachers? A VR walkthrough of three iCAST spaces with 17 teachers, eight school leaders, one architect, and one school consultant helped me identify 50 affordances in line with three themes outlined by Frelin and Grannäs’s (2022) empirically generated TEALE model: Material, Organizational, and Educational affordances. Beyond these themes, participants alluded to two additional themes that I have termed Nurturing and Values-Oriented affordances, which I have come to view as the connective tissue between the three themes identified in the TEALE model. Within these two additional themes, nine additional affordances were identified. This project produced spatial profiles for each of the three iCAST spaces studied. These profiles detail the affordances for learning, or the opportunities offered by the space in Tables 14-16.

Gibson’s (1979) theory of affordances emphasizes the individual’s perspective, suggesting that including a wider range of iCAST stakeholders—students in the data collection—could have led to more comprehensive spatial profiles. Since ILEs aim to empower student agency in space utilization (Young, 2020), their perspective would be invaluable in developing these profiles further. The initial profiles are, however, intended to serve as a springboard for future endeavours. They inform the design and development of curriculum, pedagogy, and professional development opportunities as the iCAST project moves forward.

To understand educators’ perceptions of spatial affordances, and subsequently, what might be required to develop and enhance their spatial literacy, it was necessary to explore the question: What influences the way educators perceive learning environment affordances? The TEALE model was built on the premise that teachers teach, and students learn something, somewhere from someone (Grannäs & Frelin

2017). Thus, perceptions about the learning environment are built on deeply entrenched notions of curriculum theory and the way teachers think about the purpose of education. As a teacher at an IB World School operating in Canada, I explored the Anglo-American tradition of curriculum and the Continental European tradition of Didaktik. These two traditions were also examined in the development of Frelin and Grannäs' (2022) TEALE model.

Regardless of which version of curriculum theory is followed in the Anglo-American tradition, the goal of providing a structured framework to transmit knowledge that is determined by varying layers of educational hierarchy is common to all. Teachers' perception of affordances during the VR walkthroughs largely reflected their training in this tradition—ways of knowing, being, and doing in learning spaces emerged as deeply entrenched when considering how they might enact their current learning objectives in the new spaces. Teachers typically commented on how to adapt existing teaching methods to fit spatial affordances. Exceptions to this insight were found among teachers of embodied curriculums like the Arts and Physical Education, and among JS teachers identifying in-house expertise that can be leveraged when developing spatial capacity. Despite the challenge posed to teacher mental models, many teachers also indicated through their descriptions a willingness to imagine themselves in the space despite not yet knowing how to use it. Leadership, in contrast, commented more on how the space could be used as a catalyst for transformative learning experiences beyond adapting old methods. Their perception reflected more ideal-state, research-based knowledge, and empathy, which was expressed to enact change management practices to support teachers in developing the capacity for evolving teaching and learning practices.

Throughout this study, it was evident that the purpose of education is indeed evolving, and continued momentum requires that we blend the practical competency-based approaches of the past with the growing embrace of constructivist learner-centred pedagogies.

In this area, the concept of Bildung, central to the Continental European Didaktik, sparks particular interest. Bildung emphasizes activating students' potential for societal participation and contributing to the common good rather than focusing solely on achieving predefined learning outcomes. This decades-old philosophy feels relevant to the two emergent themes presented here: nurturing and values-oriented affordances as connective tissue between those themes offered by the TEALE model. This tradition, emphasizing societal participation, aligns with the OECD's (2019) perspective on 21st-century education becoming increasingly integrated within a larger ecosystem where:

> …decision-making is no longer controlled by a select group of people, rather it is shared among stakeholders of the education system, e.g. parents, employers, communities, and students. Additionally, all stakeholders increasingly work together and assume responsibility for a student's

> education, including the student. Rather than students being acted upon by the education system, they have become active participants and change agents in the system alongside teachers and principals and are learning to be responsible for their own learning (p. 13).

This research revealed that both teachers and leadership bring valuable knowledge and priorities to the table. Both practical and strategic needs were perceived when identifying affordances within the iCAST. These differing perspectives highlight the importance of a participatory transition process, which engages multiple groups to ensure a broad organizational understanding of the aims of the iCAST. For various reasons, many participants lacked the opportunity to participate in the full iCAST design process and were, consequently, unfamiliar with the intended use of the iCAST spaces, making it difficult to consider how they might leverage spatial features to meet the aims for the building.

Support was demonstrated in this study for using the TEALE model as Frelin & Grannäs intended, as a tool to "further understanding and support dialogue" and "for collegial discussion on the use of new kinds of learning environments" (p. 256). Participants' perception of spatial features that would enable or constrain their approaches to teaching and learning fit easily within the themes of material, organizational, and educational affordances and conversations held during the teacher workshop. Thus, an understanding of the interplay between these themes and the emergent themes of nurturing and values-oriented affordances was revealed. Particular mention was made concerning how the spaces supported wellbeing and our values of inclusion and community. Support for using an affordance-based approach to transitioning into ILEs was seen in other studies, though termed differently, the outcomes all focused on "innovative learning," as cited in Young (2020) (deep student learning) and Bøjer (2021) (Improved pedagogical practice / Innovative Learning).

To build on current perceptions of spatial affordances uncovered by this project and take the next steps in what ILETC identifies as the "early transition stage" of their "Spatial Transition Pathway," I have proposed five practice implications: three focus on developing capacity in teachers and two focus on a re-visioning of the aims and future possibilities of the iCAST. In addition, the possibility exists to contribute strategies as they are developed to the ILETC Spatial Transition Pathway, which would expand our learning network and continue to enrich our practice.

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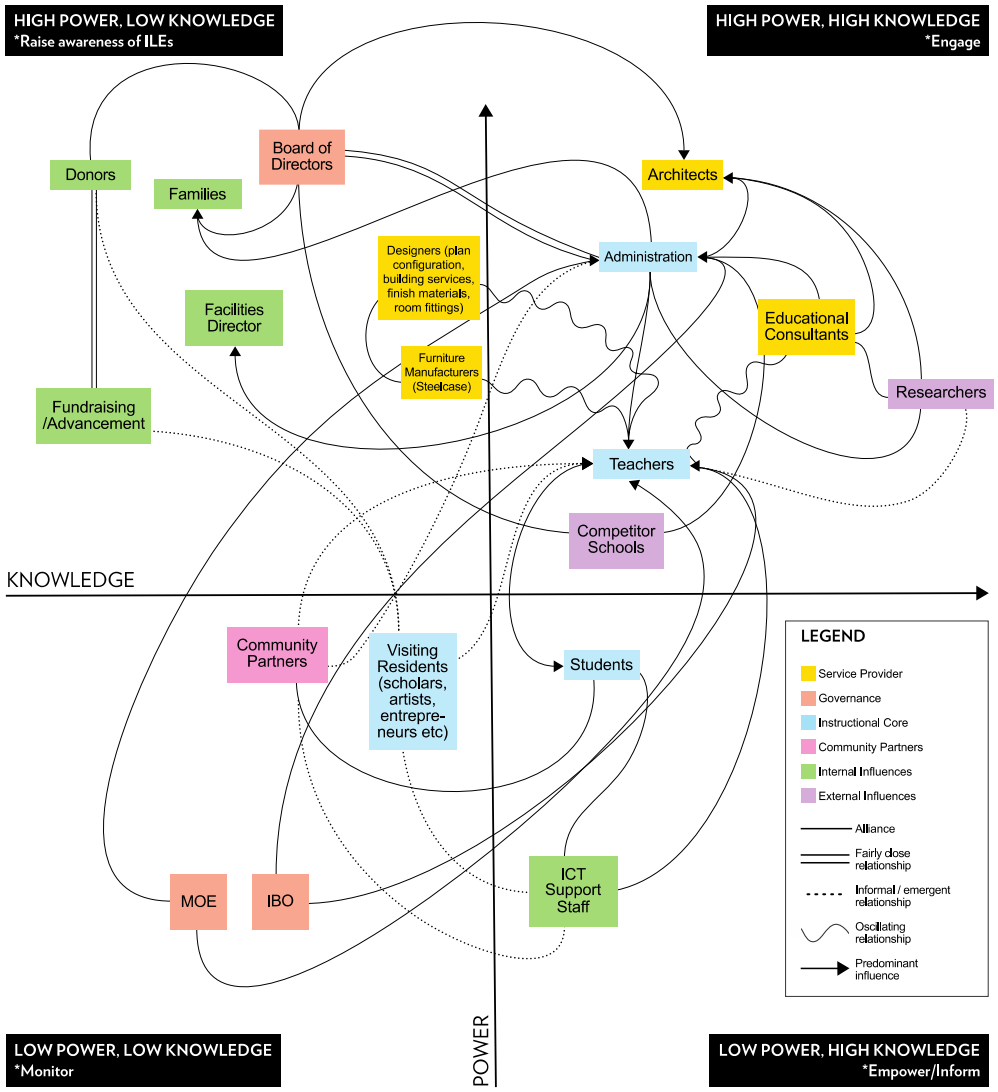
APPENDICES

APPENDIX A

Actors Map

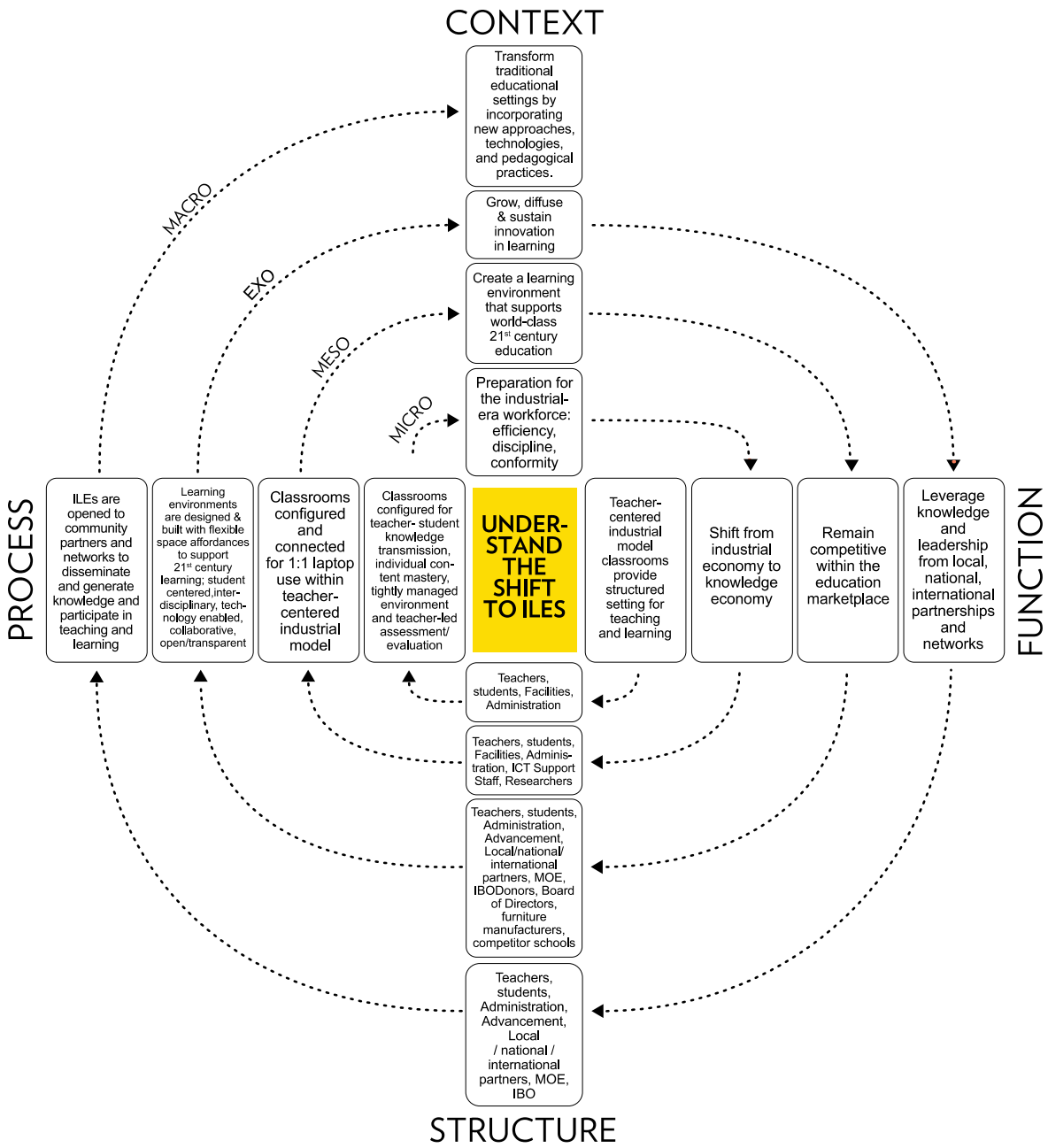
Current State System: Actors are arranged according to their level of relative power within the system/ability to change the system and their level of knowledge about classrooms/ILEs



APPENDIX B

Iterative Inquiry

Current State System: Component levels that influence the shift from traditional classrooms to Innovative Learning Environments (ILEs)



APPENDIX C

CODEBOOK

Deductive Codes:

Based on the TEALE Model (Teachers Evaluations of Affordances in Learning Environments) Proposed by Frelin & Grannäs, 2022

MATERIAL AFFORDANCES

CODE	DESCRIPTION
SPACES/ZONE	• Small Group/Breakout Space • Large Space/Commons • Street space • Steps • High Ceiling • Floor/Carpeting • Workshops (Wood/Metal) • Multi-use zone - single or multiple classes/groups can use a zone at once for different activities • Connectivity - charging stations, AV resources (large screens, projectors, speakers & associated setup) • Writable Surfaces (whiteboards, glass walls) • Large Screen • Surfaces to Work on (tables, benches, counters) • Adjoining Space • Display/Storage Shelving • Tools/Tech (Hand tools, power machines, technology applications)
ORGANIZATIONAL AFFORDANCES	
PEOPLE/GROUPINGS: *Who will be in the space & how will it be arranged?*	• Group size (Indiv/Sm/Lg)/capacity of space • Small <10 • Large >10 • Staffing, industry experts, support staff

	• Placement of furniture - moveable, varied furniture that can be configured in a variety of ways for both students and teachers for flexible grouping arrangements. • Co-Teaching - Facilitation of large groups (2 or more classes) by 2 or more teachers/experts • Retractable Walls, privacy dividers • Audience (group of people who are integrated into the learning experience) • Glass Walls
TIME/SPACE STRUCTURES *When will educational activities take place and what organizational structures support success?*	• Timetabling • when considering educational activities running concurrently i.e.: all design sections • Interdisciplinary section i.e.: a Gr 10 history and geography section, a JS/MS cohort • Common team planning time - requirements for inter/transdisciplinary projects, team teaching units/modules • Flexible booking options • full/half day • Combined bookings (i.e.: pitch & robotics) • Open studio time • Curriculum - Enabling/constraining factors of the IB Diploma curriculum, scope/sequence of skill development • School Culture - related to mission, vision & values (creativity, inclusion, sense of community, making a difference)
EDUCATIONAL AFFORDANCES	
GENERAL ACTIVITY *Why was this space chosen for a particular educational activity, what will take place?*	• **HOW the learning spaces will be used** • Viewing things on a large screen • Lectures – includes instructional lessons • Guest Speakers • Performances – arts, robotics competition • IDU (Interdisciplinary Unit between 2 subjects in Grades 7-10) • Group 4 Project (Collaborative Sciences Project in Grade 11)

	• PYP Exhibition – Grade 6 culminating special interest project • IA (Internal Assessment – subject-specific assessment of skills and knowledge in Grade 12, 1/subject) • Problem-solving • Pitching • Debate • Robotics – class activities • Group discussion – conversations formal and informal, partner talk • Group Collaboration – planning, designing, and preparing projects • Presentations • Peer learning – within the same class, between classes, between age cohorts • Brainstorming • Ideating • Building/Modelling/Making • Homework/Study – reading, writing, drawing, researching • Performance – skits, music, dance • Guest Speakers • Practice Space – filming, speaking/presenting, rehearsing • Tech Demos

Inductive Codes:

SPACE & PEDAGOGY

CODE	DESCRIPTION
INTERDISCIPLINARY	• Projects involving the collaboration of two or more disciplines where concepts and methodologies are blended to solve real-world problems • STEAM is a common example, but many examples are possible at all levels from junior school through senior school
EXPERIENTIAL/ PROJECT BASED	• Student-centred approaches, active rather than passive engagement in learning • “Hands-on” activities or experiences • Simulations, interactive activities, building/making, immersive learning
COLLABORATION/ TEAMWORK	• Active learning strategies • Students work and learn in pairs or small groups • Problem-Solving
TRANSDISCIPLINARY	• A holistic approach that transcends individual disciplines • Inquiry-based activities
DIFFERENTIATED/ PERSONALIZED	• Student-centred • Diverse approaches cater to individual needs, preferences and interests • Centres voice and choice around all aspects of educational experience • Independent learning
PASSIVE INFORMATION DELIVERY	• Project launch • Showcase of learning

ACTIVATION CONSTRAINTS

CODE	DESCRIPTION
NOISE	• People in the building • People in transit • People working in shops, open areas, adjoining spaces
OPENNESS	• Barrier-free spatial openness • Glass walls • Adjustable space size
CIRCULATION/ SPACE NORMS	• Where people can be and when • Stewardship of spaces • Expectations of users • How to move through the building • Hours, accessibility • Sharing of space
BUILDING TRAINING	• How to adjust spaces • Retractable walls • Furniture • Elevators • Lighting / AV • Collaboration with others in the building - shop experts, building manager/bookings • Onboarding (ongoing)
SPACE PRESSURE	• Space for machines/tools • Small capacity spaces • Space where things can be left • Fixed Robotics Arena (not always in use, takes up a lot of space)
TECHNICAL SKILLS & KNOWLEDGE	• Students and teachers
STORAGE/ DISPLAY SPACE	• Types of storage - fixed, non-fixed • Shelving, cabinets • Size • Location • Evidence of learning (display)
DISTRACTIONS	• Glass • Movement of people behind glass, through spaces

	• Close proximity to other groups, unobstructed sight lines • Other students / activities • Elevator
PRIVACY	• Sensitive topics in discussion • Health matters in PHE • Personal stories etc in ENG • IP discussions in Entrepreneurship program
SAFETY	• Stairs - Height, depth, sharp corners • Machines/tools
ACCESSIBILITY	• Neurodiverse learning needs - consider LSP (learning strategies plans) and other forms of accommodation • Visual/audio impaired learning needs • Mental health/Anxiety • Disabled people • Equipment accessible to all ages
MINDSET	• Comfort with open, high visibility spaces vs enclosed, private spaces

MISCELLANEOUS

CODE	DESCRIPTION
INVITING ATMOSPHERE	• Furniture and lighting arranged in such a way as to feel welcoming and comfortable • Casual, less formal feeling/atmosphere than the classroom • Non intimidating environment, yet also has an 'elevated' air of professionalism
EQUITABLE BOOKING / PRIORITY SYSTEM	• Booking system priorities • Equity in scheduling spaces
OPTIMAL ENVIRONMENT FOR WELLBEING	• Natural light • Visible green space • Change of scenery / environment • Social, emotional learning (SEL)
LEARNING ON DISPLAY	• Openness, and transparency created by glass walls/dividers and retractable walls allow for • Inspiration • Curiosity • Chance / Impromptu encounters • Clear sight lines within the building
ZONE OF PROXIMAL LEARNING	• Learning by seeing other things going on around you • Casual observers become students • Exposure to new tools, techniques and technologies • Engagement with performance presentations
ASSESSMENT AND EVALUATION	• Longer project deadlines to accommodate space • Stagger project deadlines to accommodate space availability
AMPLIFY CURRENT MAKER PROGRAMMING	• Current program, but amplified because of increased capacity: • Larger space • More tools, machines, technologies, support staff
STUDENT AGENCY	• Resources/materials/tools in open displays to encourage student interaction and choice • Choice: • Where / how to sit (or stand) • Type of furniture that is most comfortable • Arrangement of furniture • How to work – alone, in pairs, in groups, virtual

	• Types of resources/materials/ technology to use
FLEXIBLE STUDENT ENGAGEMENT	• Student engagement that does not rely on traditional methods • Desks • Notebooks / laptops • Classroom configurations • Classroom participation
FLEXIBLE SPACE	• Variety of space sizes • Adjustable space size • Acoustic absorption • Open space allows for student agency • Space that allows for lesson fluidity • Adjoining spaces allow for movement and iteration between parts of a project • Mobile / reconfigurable furniture
COMPLEMENTARY SCHEDULING	• Consideration of what activities can and cannot be scheduled side by side to create an optimum learning experience for all
SPATIAL ENGAGEMENT PRACTICES	• Rules of engagement in the spaces • Behavioural norms • Classroom management • Teacher / student preparation, onboarding (ongoing) • Culture of Innovation
ENGAGING SCHOOL VALUES	• Sense of community • Creativity • Inclusiveness • Making a Difference
ACTIVE LEARNING ZONES	• Students are not in a static configuration • Opportunities to get up and move around to engage with learning • Move through functional zones of the building fluidly for different purposes (same project) • Learning is embodied
DYNAMIC COLLABORATION	• Presentations, performances, demos, social interactions, connections that are: • Pop up • Impromptu

	• Spontaneous • By chance
ACTIVATING POTENTIAL	• Envisioning the future • Motivation • Inspiration • Dream • Connecting with possibilities beyond the imagination

APPENDIX D

STAKEHOLDER WALKTHROUGH DISCUSSION GUIDE

Introductions

Introduce yourself, the project and why you have asked for a walkthrough.
What to expect during the walkthrough
Define the goals, research questions and hypothesis of the project… what do we want to learn? What will we actually do with the insights we gather?
Review consent
Leave time for participants to ask any questions before beginning.

Thank you for agreeing to participate in my research study. My name is Allison, and I am a MDes (Strategic Foresight & Innovation) candidate at OCADU. The goal of my research is to better understand the architect, school leaders and teachers' perceptions of architectural affordances inherent in the iCAST and based on this, explore how we might support the activation and use of the iCAST as a pedagogic tool.

The walk-through method was chosen as a way to build empathy and understanding around the useability features of the iCAST as perceived by multiple stakeholders at this stage of the project.

For this session, I have posed the following research questions:
What are learning environment affordances?
How are the affordances of Innovative Learning Environments (ILEs) perceived?
*In this context I am using the term ‘affordances’’ to encompass:
Qualities of the learning environment (space, objects and people) which may be perceived to enable teaching and learning activities and behaviours.
*In this context the iCAST is considered to be an Innovative Learning Environment which is defined as:
The product of innovative space designs and innovative teaching and learning practices, highlighting the importance of relations between space and behaviour.
To better understand my overarching goal, I would like to take you on a Virtual Reality (VR) walkthrough of the iCAST as a subject matter expert:
The design architect of the iCAST
The architect of record for the iCAST
A member of the school leadership team involved in the visioning of the iCAST
A teacher, end user of the iCAST

I would like to acknowledge that while student presence will be a critical influence on the lived experience within the iCAST, obtaining the perception of students on architectural affordances was considered to be outside the scope of this study.

Before we begin, I would like to go over the consent form with you.

I will be recording the screencast of what you are seeing in VR as well as the audio of your narration of the walk-through. Do I have your consent to screen and audio record this session?
Thank you for providing consent.

In addition, I would like you to know that:

This project is being conducted in fulfilment of my Major Research Project in partial fulfilment of my MDes from OCAD University.
Everything you share is confidential and used for academic research purposes only.

Do you have any questions before we begin? Please let me know at any time if you want to stop the session.

Shall we begin the session now?

Begin the Walkthrough

iCAST 360 Tour Link

Instructions for participants:
You are about to embark on an exciting and immersive journey. To ensure a safe and enjoyable experience, there are a few pointers I would like to share before we begin. Let's ensure that the headset fits comfortably on your head by adjusting the straps as needed. Now, we'll take a moment to adjust the interpupillary distance, this will align the virtual world perfectly with your eyes. VR can be intense, and some users may experience motion sickness, so don't hesitate to request breaks if needed. I will be here as a spotter to ensure you are safe in your surroundings. You might see a blue ring on the floor when you look down. This is the 'safety boundary' set up to ensure the optimum experience from the headset and to keep you from bumping into anything. Next, please familiarize yourself with navigating the VR menu at the bottom of your view (bend your head down) and notice the 'white laser' pointer controlled by the

handheld controllers, you can use it to select options on the menu. Give this a try now. We are going to begin at the 'Exterior View', practice turning around and looking up and down to get a sense of the 360 power of the VR experience.

We are going to enter 3 spaces during this tour:
The lower-level Pitch Space
The Robotics/Design Space
The Noodle/Ideation Garage

In each space, I will provide you with 3 prompts to respond to, your answers will be audio-recorded. I may also add a few additional prompts depending on your responses.

Do you have any questions?

Are you ready to begin?

TEACHERS:

Go into the Pitch Space… look around…
How do you see yourself using this space - please comment on specific spatial features (those things that are non-portable, like staircases, glass partitions etc) and artifacts (those things that are portable, like tables & chairs etc). Describe how these things would enable learning activities in your classroom.
What challenges to your practice can you foresee?
Are there other possibilities you can envision for this space, things you may not have tried, but that the space presents opportunity for?

Look down, click on 'Next View' to enter the Robotics Lab/Design Space

Go into the Robotics Lab/Design Space (Metal/Woodworking) … look around…
How do you see yourself using this space - please comment on specific spatial features (those things that are non-portable, like staircases, glass partitions etc) and artifacts (those things that are portable, like tables & chairs etc). Describe how these things would enable learning activities in your classroom.
What challenges to your practice can you foresee?
Are there other possibilities you can envision for this space, things you may not have tried, but that the space presents opportunity for?

Look down, click on ‘Next View’ to enter the Noodle/Ideation Garage

Go into Noodle/Ideation Garage … look around …
How do you see yourself using this space - please comment on specific spatial features (those things that are non-portable, like staircases, glass partitions etc) and artefacts (those things that are portable, like tables & chairs etc). Describe how these things would enable learning activities in your classroom.
What challenges to your practice can you foresee?
Are there other possibilities you can envision for this space, things you may not have tried, but that the space presents opportunity for?

Look down, click on ‘Home View’ to return to the Exterior of the iCAST and complete your tour.

Potential Secondary Prompts:
How might this space enable interdisciplinary learning?
How might this space enable collaboration and teamwork?
How might this space enable personalized or differentiated learning?
How might this space enable experiential learning?

ARCHITECTS/SCHOOL LEADERS:

Go into the Pitch Space… look around…
Describe your vision for how teachers can use this space - please comment on specific spatial design features (those things that are not portable, like staircases, glass partitions etc) and artifacts (those things that are portable, like tables, chairs etc)

Look down, click on ‘Next View’ to enter the Robotics Lab/Design Space

Go into Robotics Lab/Design Space (Metal/Woodworking) … look around…
Describe your vision for how teachers can use this space - please comment on specific spatial design features (those things that are not portable, like staircases, glass partitions etc) and artifacts (those things that are portable, like tables, chairs etc)

Look down, click on ‘Next View’ to enter the Noodle/Ideation Garage

Go into Noodle/Ideation Garage … look around …

Describe your vision for how teachers can use this space - please comment on specific spatial design features (those things that are not portable, like staircases, glass partitions etc) and artifacts (those things that are portable, like tables, chairs etc)

Look down, click on ‘Home View’ to return to the Exterior of the iCAST and complete your tour.

Potential Secondary Prompts:
How might this space enable interdisciplinary learning?
How might this space enable collaboration and teamwork?
How might this space enable personalized or differentiated learning?
How might this space enable experiential learning?

Wrap Up

Identify the conclusion of the walkthrough
Chance to ask any questions / provide feedback
Thank participants for their time
Explain what happens next
Leave your contact information in case they have follow-up questions

We have reached the end of our session.

Do you have any questions for me?

Thank you for your time. I will review and analyze the data gathered today and I will then draft a list of affordances identified during this session.

On January 17, 2024, the teacher participant segment will re-convene for a focus group discussion based on the outcomes of today’s walkthrough.

The architect(s) and school leadership participation in the study is now complete.

Should you have any questions as the study advances, please don’t hesitate to be in touch via the email provided.

APPENDIX E

TEACHER WORKSHOP DISCUSSION GUIDE

WELCOME: 5 Min
Please have a snack!
Thank you for attending this workshop
Consent for your participation in this focus group was collected during the VR walkthrough.

WARM UP: 10 Min
What was one space or feature of the iCAST you saw during the VR walkthrough that you are excited to use to enhance your classroom practice? Some of you were unable to participate in the VR walkthrough, so please just consider any knowledge you have of the spaces or perhaps just pose a question or tell us something that you are curious about

INTRODUCTION: 5 Min
The goal of my research is twofold:
To better understand school leaders' and teachers' perceptions of design affordances of the iCAST
Just to recap - the term affordances means: The qualities of the learning environment (space, objects and people) which may be perceived to enable teaching and learning activities and behaviours.
In the VR walkthrough, I was asking you to identify features that would afford you specific learning opportunities, or actions based on your current or future practice.
The term affordances refers to the identified feature combined with the action, these can be positive or negative, I'll show you an example that emerged from the data. (Slide Deck)
To explore how we might support the activation and use of the iCAST as a pedagogic tool to meet the aims of the school's strategic vision.

For the purpose of this session, I have posed the following questions:

What spatial qualities enable and/or constrain the Principle Aims of the iCAST building
How might we recognize the potential of space as a pedagogical tool to achieve the principal aims of the iCAST building?

Having reviewed your VR walkthroughs, I have compiled a list of spatial features and their action possibilities (or affordances).

In our session today we will be reviewing the principal aims of the iCAST, and considering how the spatial features you identified in the VR walkthrough might enable or constrain these aims.

I chose to use a workshop group in addition to our VR walkthrough to bring teachers together after the VR experience to build on each other's ideas and create an exploratory dynamic amongst this key end-user group.

Before we begin, I would like to remind you that I will be audio recording parts of this session on Voice Memo and I will be collecting your visual diagrams and photographing them.

In addition, I would like you to know that:
Everything you share is confidential and used for academic research purposes only

Do you have any questions before we begin? Please let me know at any time if you need to leave the session.

Shall we begin the session now?

Begin the Session

PREAMBLE/SET UP: 5 Min
Posted around the room are 6 posters. Each poster has one of the iCAST Aims at the centre. The aims of the iCAST are to provide space for:

Engaged and networked communities of practice
Accessible learning activities that invite intentional play and risk-taking
Interdisciplinary and transdisciplinary approaches to solving "grand" and "micro" challenges
Flexible and inclusive learning spaces supported by innovative technologies
Innovative and accessible measures of learning
Societal and cultural images and environments that promote diversity and opportunity in STEAM

Provide pens and Sticky Notes to each pairing/group:
Green - Enabling
Blue - Constraining

Around the Aims are the spatial qualities emergent from the stakeholder walkthrough.
Please consider which iCAST aim is most interesting to you and move yourself in front of that chart.

Instructions:

PARTNER WORK: 15 Min

Review the aim in relation to the spatial qualities that surround it and discuss your thoughts with your group.

It is likely that each aim only connects with a few spatial qualities.

If you have questions or discussion points regarding your aim, or additional aims you think should be included in this list please write them on one of the separate sheets of chart paper provided.

Circle the spatial qualities that enable the aim on your chart paper. Use a blue sticky note to jot notes that explain your reasoning (include the number of the spatial feature)

Circle the spatial qualities that constrain the aim on your chart paper. Use a green sticky note to jot notes that explain your reasoning (include the number of the spatial feature)

SHARE OUT: 20 Min

Share out your group's iCAST aim and the decisions made around its relationship to the various spatial qualities.

Wrap-Up: 10 Min

Next step - I pull together and analyze all the data and write my paper which will include recommendations for the next steps in supporting our community to activate the aims and use the iCAST as a pedagogic tool.

Do you have any questions?

Thank participants for their time

Please reach out to me if you have any questions via the email provided