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# Designing and using innovative learning spaces: What teachers have to say

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Ambienti di apprendimento innovativi. Ripensare gli spazi della scuola tra pedagogia, architettura e design

# Designing and using innovative learning spaces: what teachers have to say[1]

Progettare e utilizzare spazi di apprendimento innovativi: cosa hanno da dire gli insegnanti

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## ABSTRACT

There is no universal definition of what constitutes an innovative learning environment, because each school is unique. Plans to Pedagogy, developed by the University of Melbourne's Learning Environments Applied Research Network (LEaRN) team, is exploring issues schools identify as they transition to and use innovative learning environments. Embedded in a range of schools across Australia and New Zealand, each school is assigned an academic who works with them to co-design a project targeting the school's identified spatial challenge. This paper overviews the eight current Plans to Pedagogy projects to give a sense of the issues faced by teachers in terms of using learning environments well. It then focuses on two projects for a deeper examination to illustrate how the researcher/school partnership operates.

## SINTESI

Non esiste una definizione universale di ciò che costituisce un ambiente di apprendimento innovativo, perché ogni scuola è unica. *Plans to Pedagogy*, programma sviluppato dal team LEaRN (*Learning Environments Applied Research Network*) dell'Università di Melbourne, sta esplorando i problemi che le scuole individuano mentre sperimentano e utilizzano ambienti di apprendimento innovativi. Esso è attuato in una serie di scuole in Australia e Nuova Zelanda: a ciascun istituto viene assegnato un ricercatore che lavora per co-progettare un piano mirato alla sfida spaziale identificata dalla scuola stessa. Questo documento presenta una panoramica degli otto attuali progetti *Plans to Pedagogy*, per dare un'idea delle problematiche affrontate dagli insegnanti in termini di utilizzo corretto degli ambienti di apprendimento. Si concentra poi approfondendo due progetti, per illustrare come opera il partenariato ricercatore/scuola.

KEYWORDS: teacher-led research, pedagogy, school improvement, furniture, participatory planning

PAROLE CHIAVE: ricerca guidata dal docente, pedagogia, miglioramento scolastico, arredamento, progettazione partecipata

[1] This paper is based on a presentation of the same name, given by the authors as a Twilight Lecture, Edith Cowan University, Western Australia on April 26th, 2021.



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## Introduction

Schools are increasingly embracing the concept of Innovative Learning Environments (ILEs); with the recent Innovative Learning Environments and Teacher Change (ILETC) project finding they constitute more than 25% of all spaces in New Zealand and Australian schools (Imms et al., 2017). Given this popularity, the ongoing challenge is to both determine their impact, and use that information to inform further development. There has been steady progress on the former, researchers can isolate space as a variable and provide evaluations of ILEs utilizing measures such as test scores, attendance, and standardized measures of engagement (Barrett et al., 2015; Byers et al., 2014; Byers et al., 2018). Research has also focused on affective issues, such as ILE pedagogies that facilitate critical and creative thinking, and the achievement of communication and collaborative skills (Beghetto & Kaufman, 2014; OECD, 2006; Young et al., 2020).

More difficult is the latter, the dissemination of these findings to improve practice. It is here this article is focused, addressing how we gather evidence that speaks to the teachers who use these spaces, as well as the mechanisms needed for teachers themselves to collect, analyze, interpret and disseminate quality examples of practice. The Plans to Pedagogy (P2P) Program is one example of how teacher voice can value-add to research. The benefit of undertaking a co-design, collaborative research approach with teachers is two-fold: the data collected from the P2P provides evidence of how ILEs are being used in practice, and the collaboration between LEaRN researchers and school-based teachers and leaders provides an example of how to build capacity within schools to undertake spatial evaluations. We argue the result is well-designed research outcomes exhibiting the authenticity of school-based practice.

Each of the eight current P2P projects is unique. Each school within the program is at a different stage of ILE development; some are transitioning to flexible spaces from more traditional arrangements, others have a long history of working in a flexible environment but do not necessarily have evidence to explain their pedagogical decisions as a school to a wider audience. The aim of the program is to help each school build data unique to their space/s and context, while contributing effective results to the broader conversation on how ILE spaces are successfully being designed and occupied by teachers.

## 1. Background

This article unpacks selected P2P projects to illustrate how this collaborative school-based research approach works in real life. It begins with the group's common understanding of what constitutes an ILE:

- flexibility of the learning spaces to be reconfigured to suit a range of specific learning tasks (Butin, 2000; Dovey & Fisher, 2014; Leiringer & Cardellino, 2011; OECD, 2006);

- a range of furniture to assist different types of learning (Dudek, 2000; Imms et al., 2020; Oblinger, 2006; Saltmarsh et al., 2015);
- integration of all available and relevant technologies (Fletcher et al., 2020; Lomas & Oblinger, 2006);
- use of informal spaces beyond the classroom: recognizing that good learning happens anywhere – in hallways, outdoors, in social areas (Boys, 2009; OECD, 2015).

These design imperatives are intended to help students engage in critical thinking, support their communication skills, help them to be more creative in how they think and learn in both collaborative and individual learning (Beghetto & Kaufman, 2014; OECD, 2006; Young et al., 2020). But history has shown the pitfalls of ignoring the teachers. In response to this, and first articulated by the OECD (2015) and refined for the Innovative Learning Environments and Teacher Change (ILETC) project (Mahat et al., 2018), the characteristics of an ILE listed above are linked to actual practices. So, in terms of a working definition, innovation is considered synonymous with change, the adoption of new applications; in our context this change occurs as the two historically unconnected organisms, space and teaching, are conflated (Mahat et al., 2018). Like the OECD, P2P believes ILEs are this symbiosis of two phenomena – innovative design and innovative practices. Only when these work well in conjunction is an innovative learning environment created.

### 1.1. Innovative learning environments and their impact on learning and teaching

While ILEs are considered a response to 21st century learning skills, they are not a revolution. They have been incrementally developed for decades, with a policy emphasis post-World War II (Mahat et al., 2018). Now, ILEs are more than the largely architectural response to student-centered learning that doomed the 1970s iterations. As ILETC emphasizes, ILEs are a pedagogic tool that, if well understood, assist educators to make good teaching even better. They are only one component of a larger complex adaptive system (Cleveland, 2018; Fisher & Dovey, 2014), yet an important one to consider. Studies now show strong correlation between ILEs and improved high-impact teaching (Hattie, 2012), as well as increased student deep learning (Murphy, 2020). The successful alignment of spaces and pedagogies improve academic achievement in English, mathematics, and science (Barrett et al., 2015; Byers et al., 2014). But effective practice in ILEs is not only about teachers developing 21st century learning skills and improving academic performance in students, it is also about how teachers engage with their colleagues to improve practices over time (Young et al., 2021).

### 1.2. Evidence-based practices in schools

While there is a significant body of work on the evaluation of teachers' practices, the intersection of teacher pedagogy and learning environments is less researched (Blackmore et al., 2011; Cleveland & Fisher, 2014). Evaluation is a necessary

process to inform evidence-based reporting, which many international education ministries are mandating for school accountability (Altrichter & Kemethofer, 2015; Keddie & Holloway, 2020). However, the need for evidence-based practices can create tension in terms of how good practice or good learning is measured. For example, in Australia, the Education Council (2019) requires school staff to create and sustain learning environments that support students' individual needs; yet academic performance is still the primary measure to evaluate educational success (De Nobile et al., 2013; Gurd, 2013; Lauen & Gaddis, 2016). While standardized evaluation is needed, Hofman and colleagues (2009) argue that big data should be viewed alongside more contextualized evaluations conducted at individual school level. This approach provides complementary data that considers the unique issues facing a school community to explain why and how things are done within the school culture.

While evaluation can be perceived as negative because it generates more work for teachers, it can also be an empowering process. Teacher involvement in school evaluation and reform measures can improve uptake of the resultant learning or changes by increasing staff ownership in the process (Burns & Machin, 2013; Nguyen & Hunter, 2018). Importantly, when evaluation is developed by and with staff, the school's specific priorities drive the focus of the evaluation and allow for connections to be made between wider educational reforms and the reality of the profession as experienced by the school staff (Walker et al., 2014).

### 1.3. Teachers as researchers in co-design methods

Building sustainable professional learning practices can support teachers' transition into ILEs or evaluation of their practices within ILEs (Blannin et al., 2020). Teachers are researchers in schools is not a new phenomenon; Kemmis (2001) describes the importance of the «self-education of teachers and school communities who want to raise and answer the questions they regard as most pressing in their own situations» (p. 17). Of course, teachers and leaders who experience their school context daily already have a good insight into what works and what can be improved. Co-design and participatory design research processes aim to formalize their self-education through bringing together teachers' and leaders' knowledge of context with researchers' knowledge of methods to conduct rigorous evaluation (Avgitidou, 2009; Bruce et al., 2011; Ross et al., 1999). This type of method brings each parties' strengths to the research, encouraging a collaborative relationship in which each party is considered expert in their field (Whitehead & McNiff, 2006). Active collaboration in all stages of the research also supports teachers' development of research skills, professional learning extends beyond the scope of the co-designed study and can enhance teachers' long-term practice (Dimmock, 2012; Swaffield & MacBeath, 2006). The mutual benefits that can arise from this type of collaboration were important in framing the P2P project, so the pressures of engaging in evaluation work were balanced by positive outcomes for school staff.

## 2. Methods

There are currently eight P2P projects, each school has its own unique project which is under the P2P umbrella. The staff from each school and project academics typically come together twice a year to network and provide an update on their project to the group. The project has employed a rolling recruitment approach, which means that each school-based project is at a different stage of progression. Each school's project has a duration of three years and has one or two assigned academics to work with the school staff. The school appoints a spatial learning team of up to six staff members to lead the P2P project within their school, and the academics facilitate and supervise the project over this time. P2P operates with approval from the Human Ethics Advisory Group at its host university.

While each school's project is unique, all projects have a broad three-phase approach, with each phase lasting approximately 12 months (Blannin et al., 2020):

- phase one uses exploratory designs to investigate current knowledge and practices in the school, as well as what gaps exist in terms of spatial challenges faced by the school. This phase focuses on researchers working with school staff to develop a research protocol for their specific project, as well as beginning to gather any baseline data required to understand their spatial challenge;
- phase two focuses on staff or students' transition or use of space, as defined within the context of their study. This is where the spatial learning team and their academic/s work together to implement interventions and collect data that can be disseminated and inform phase 3 activities;
- phase three often continues the phase two activities but also adds the evaluation component, and sometimes adds a change in focus to the intervention (an example of this will be provided in our findings). This phase focuses on what the evaluation can contribute to shaping long-term spatial practices at the school, as well as producing outputs that share project outcomes with the school, and broader education and academic audiences.

Two key activities support the schools across the three years of their project:

- P2P workshops at the host university. These workshops are focused on research processes, such as sharing basic research methods, analysis planning, dissemination and publication strategies. They are led by the academic team, with input from the school staff (typically one or two members of each spatial learning team attend). The schools also provide an update on their specific project to enhance networking and discussion with other schools;
- two visits by the academic to the school per year. These visits allow the spatial learning team to engage with the researcher on their school site and are typically focused on examining the current phase data and planning for the next phase of the project.

Sampling for P2P was through an opt-in convenience approach, in which expressions of interest to participate were shared by LEaRN and schools who

wished to participate contacted the lead researcher. However, the eight current schools have diverse characteristics across regional and metropolitan contexts, primary and secondary schools, government and private schools, single sex, and co-educational schools.

Table 1 provides an overview of the methods used at each of the current eight schools in P2P, and the purposively sampled groups for each school's project.

| School | Research Focus | Research Approach | Methods | Participant Numbers |
|---|---|---|---|---|
| Sub Zero College | Already working in ILEs, they wanted to use evidence to guide future teaching strategies and support induction of new staff into the space. They wanted to see where and how their pedagogical approaches are having most effect. | Qualitative | Collaborative workshops; network mapping; photo documentation; staff and student survey. | 20-25 teachers across the school, student survey across the primary years. |
| Sunshine School | A Public Private Partnership (PPP) build, the architects and teaching staff never met, and the design of the spaces was done in isolation of intended teaching practices. A few years into teaching in the spaces, the staff wanted to map how their students were using the spaces, and if they were developing the learner capabilities desired by the school. | Mixed method design | Assisted repeated measures survey (spatial mapping; Likert scales measured leaner capabilities). | Total of 108 student participant across primary and secondary. |
| Archer Girls' College | With already high achieving students, the school staff saw a new middle school complex as an opportunity to explore how to generate more dynamic and engaging learning experiences for students. They wanted to generate shared understandings about how to use ILEs to promote student agency, curiosity, critical thinking, creativity, and strong relationships for their girls. | Qualitative | Pedagogical encounter mapping; focus groups; collaborative workshops. | 20–25 teachers from across the school. |
| Makybe Primary School | A significant new ILE wing was added to this old primary school. Because staff needed to work in both areas, they wanted to understand how to ensure equity of advantage. To do so, they wanted to use P2P to gather evidence about how pedagogies changed due to the different environments, and what impact this was having on children's 21st century learning skills. | Qualitative | Classroom observations; stop-motion video capture of lessons; individual interviews with teachers. | Two teaching teams (one junior and one senior primary). |

| School | Research Focus | Research Approach | Methods | Participant Numbers |
|---|---|---|---|---|
| Phar Lap Primary School | In a school where budgets restricted major infrastructure projects, they wanted to understand the specific details of how different team-teaching pedagogies within a modestly developed flexible learning space could promote student engagement. | Quasi-experimental, mixed-methods | Pre- and post-surveys of teachers; observations x 9 per class (in between 2 interventions). | Two Year 5 classes, with one acting as a control class. |
| Winx College | Already transitioning to more flexible teaching in older spaces, they wanted to gather school-focused data on the impact student-centered spatial and furniture configurations had on their teachers' practices and students' learning. | A single-subject research design using mixed-methods | Pre- and post-surveys of teachers; pre- and post-surveys of students; classroom observations. | Year 9 (1 teacher and 25 students) and Year 12 (1 teacher and 13 students) in two prototype classrooms. |
| Coolbardi Primary School | For many years, the school had been teaming with a furniture company to experiment with the use of innovative furniture designs. They wanted to see what impact their teacher and student use of furniture had on student engagement and teacher pedagogies. | A single-subject research design using mixed-methods | Teacher interviews; classroom observation; student surveys; photo elicitation. | Five classes across Years 3-6; approximately 135 students, 5 teachers. |
| Ethereal College | This school is embarking on the first major school build project for many years, an updated library and STEM center. They wanted to engage their staff on that journey and use both the planning and transition into the new space to see if teachers would embrace deep learning as a driver of new pedagogies. | Mixed methods | Classroom observation; student survey; teacher survey; collaborative workshops. | Eight teachers across primary and secondary; student surveys across Years 4-12; teacher survey across whole staff. |

TABLE 1 – METHODS EMPLOYED AT P2P SCHOOLS

While each school employed different approaches and methods to gather and analyze data, this paper will focus on two specific projects to illustrate how P2P operates and the type of impact it is having in participating schools.

## 3. Findings

The two projects described represent different approaches to P2P that has been enacted. The first project is more exploratory as the school had no existing spatial data, involved students across both primary and secondary years, and was a project designed to accommodate ongoing changes in the school structure and operations; the second was more explanatory in nature, with a primary school who had a long, stable staff and practice but wanted to take their thinking to the next level through

interrogating data. Each project had different challenges, and each project offers insight into how spatial research can be enacted in schools to extend teachers' and students' use of space.

### 3.1. Sunshine School

The first project is the journey of Sunshine School, a large composite primary-secondary school, where the staff are exploring how their complex student cohort is using their open-plan new build. The school is a relatively new, over $200 million Australian dollar build. It was designed before the school staff were employed, which resulted in teachers having to transition into an unknown space when the school opened without any spatial training or transition support. The school, situated in a lower socioeconomic area, also had a student cohort with complex issues that needed high levels of teacher support. The surrounding school community also had significant fractures, which created more complexity for staff and school leaders to manage. Nevertheless, the school staff designed an adventurous student-centered curriculum approach to engage their learners. They set up multi-year home rooms where students would make connection with a teacher who would be their advocate across their schooling journey. Rather than having a set timetable for the year, the students devised their own learning journey plan to meet the curriculum and set their own timetable on a fortnightly basis. They selected which teachers they needed to see to advance their learning and where they would complete their work. Teachers would rotate through the school's learning spaces on a fortnightly basis, sometimes offering workshops and sometimes teaching the individuals or groups who would come to see them throughout the day. Students would have approximately 10 weeks to work on their personal inquiry cross-curricular project before devising a subsequent project.

The novel student-centered approach employed at the Sunshine School meant there was a lot of student traffic throughout the day and the teachers, who were static in their timetabled location, had no evidence of how students were moving throughout the school. As a result, the Sunshine School realized they needed data about how students were using the spaces in terms of who they were with and what they were doing. They also wanted to know which spaces were most popular with students and why. They had also trialed adding new pop-up spaces in the open-plan buildings based on students' requests, and they wanted to know if these were beneficial to the majority of students. In addition, the school was conscious that traditional academic learning outcome measures did not often positively reflect the development of their learners and they wanted a different measure for success. The school had several learner capabilities they wanted to develop in students, life-long skills that would help their students both within and beyond school. These capabilities included respecting others, being responsible for their learning, being curious and being resilient. While these characteristics are not linked to space, they wanted to see if there was any correlation between how and where students were working and the positive development of these characteristics.

### 3.1.1. The method

The challenge in designing this project was that the staff wanted to map students over time but could not identify variables that remained the same in order to take repeated measures. Initially they wondered about mapping student success via their learning outcomes, but with personal projects changing approximately every 10 weeks and all students working on different content, there was no consistent measure to map space against student achievement. After a few meetings with the spatial learning team and LEaRN academics (during which time spaces were developed, used and disassembled, new systems were put into place, teachers and members of the spatial learning team moved on from the school), it was decided to focus on the learner characteristics as an outcome variable for the study. These characteristics had remained consistent since the school opened, and they represented the core skills the staff wanted students to develop by graduation.

They developed three research questions:

- "What choices are students making about space? Where, why, and what are they doing, and with whom?"
- "How do students feel about themselves as learners, in terms of the school's learner characteristics?"
- "What relationships exist between students' choices about space and their feelings about themselves as learners?".

The spatial learning team and academics spoke in depth about the research approach they wanted to use for P2P. Their aim to map students over time necessitated a repeated measures design, and the spatial learning team explained how they wanted data that would appeal to policymakers and leaders: they wanted some numbers. A more quantitative approach also aligned with the need to map: the spatial learning team wanted to know where their students were working, who they were working with, what they were doing, and why they had chosen their working location. Yet not all students had access to devices to do online surveys, and there was high transience in the school population that had to be managed throughout data collection. Consequently, the research employed an assisted survey approach, whereby a relief teacher (who had previously had a relationship with the students) would locate the sample of students four times across the year and ask them the questions on the survey (or give them the survey to complete in their presence, depending on the age and behavior of the student). To test the efficacy of this method, the school invited a small group of students across primary and secondary (Years 5, 8 and 11) to complete the surveys. They took a purposive sample of approximately 50% from each year group, resulting in 110 students being sampled.

The survey itself only took 5-10 minutes to complete. It asked the four simple mapping questions:

- "What space are you working in?"
- "Who are you with?"
- "What are you doing?"

- "Why did you choose this space?".

It then presented a series of Likert scales to measure each of the learner characteristics, using items that were co-designed by the LEaRN researchers and spatial learning team. An example from these scales is "I am curious about my learning".

The spatial learning team felt confident to analyze the mapping data through frequencies, and the LEaRN academics supported them to analyze and interpret ~~to~~ the Likert scale data. The spatial learning team first computed frequencies for the learner characteristics, looking at how many students positively/negatively responded to each item to understand how their students were responding to the items generally (both as a school, and for each year group). The academics supported the team to answer the last research question through Kruskal-Wallis tests, to determine group differences between where students were working and their response to learner characteristics, and post-hoc Mann-Whitney U tests to determine where these differences were statistically significant.

### 3.1.2. The findings

After one year of data collection (four survey occasions), the spatial learning team found that most students tended to work in the flexible, open spaces around the school as compared to the purpose-built specialist spaces (e.g., the science labs and art room). Despite the significant autonomy in student learning causing some concern about on-task behavior among staff, most students (93%) reported working productively when asked "what are you doing" and only 7% reported doing "nothing" when the teacher came to survey them.

Most students (59%) were working with their friends, which aligned with the collaborative approach to learning offered by the school. But there was some evidence that working with friends resulted in a lower (self-reported) commitment to learning than if the students worked individually or with a teacher. Only 7% of students worked on their own, and the rest worked with teachers or teacher aides (34%). However, Year 11s were more likely to work on their own than the other groups, while Year 8s were most likely to work with friends and Year 5s were more likely to work with a teacher than the other groups. Unsurprisingly, older year groups showed more time working on their personal projects than the Year 5s, who spent most of their time in workshops or teacher-led classes as well as self-exploring.

Students had three core reasons for choosing their working space: the background noise/volume of a space, they followed their friends, and they felt a sense of belonging in that space (either from the space or the people there). For example, teacher-led workshops improved student belonging. Working with teachers also improved students' responses to the learner characteristics around commitment to learning, meeting learning needs and encouraging curiosity.

When analyzed by year level, the survey data showed some aberrant responses for Year 8 students. These students had a greater neutral response to the learner

characteristics compared to the other cohorts. They accessed the same learning opportunities as the Year 11 cohort, as classes are multi-year level in the secondary space. It was possible that the difference in response was caused by the transition period from primary to secondary, was related to adolescent development, was perhaps that Year 8s prioritized friendship over commitment to learning and the other characteristics, or that the difference was related to how Year 8s responded to the school's individualized project approach. As there were several possible factors that could influence this response, the school was encouraged to follow up through future research.

While the findings begin to explain how students are working within the school, it also shows the challenges that occur when teachers and leaders are not provided support to transition into ILEs. At the time of the research, the school had been occupied for just over three years, and the teachers were still wondering about how students were using the space and what spatial decisions the students were making. The school leaders were making lots of spatial decisions to encourage students' engagement and success at school, but had no evidence base to support their planning. The process of engaging in the research made it clear that the school required some data from which to build a clear vision about the spatial implications of their learning approach, so that the spaces and practices within the school could be aligned. These initial findings highlight areas of the school that are being underutilized, prompting a discussion about how effectively spaces can be used or adapted to meet student needs. It also highlighted a need for formalized spatial professional learning to support teachers to activate all spaces for learning in both collaborative and individual tasks.

### 3.2. Coolbardi Primary School

The second case study is a retrofit project in a rural primary school, where teachers kept their existing classrooms but changed the furniture in their rooms from traditional desks and chairs to flexible furniture arrangements. The school had a long history of innovating spaces using furniture, working alongside a furniture company to try new designs and provide feedback on furniture. They had taken the approach to innovate learning environments through furniture because they had no budget to update buildings at the school, which included a range of spaces from semi-permanent structure to the original historical school building.

The school believed that their flexible furniture approach was benefiting students. However, they had no data to support their claim. They wanted evidence that their investment was making a difference to student engagement and teachers' pedagogy in their school, and the furniture provider decided to partner with them and LEaRN on a P2P project.

#### 3.2.1. The method

The core aim of this project was to gather good evidence about the impact of furniture. The school's spatial learning team had two research questions:

- "Do levels of student perceptions of their engagement in learning correlate to types of furniture provided in their classrooms?";
- "Do teaching styles (pedagogies) change with differing furniture arrangements?".

To answer these questions, the LEaRN academics recommended adopting a single-subject research design (Byers et al., 2014) in which classes would alternate between having flexible furniture arrangements and traditional arrangements across three school terms (10 weeks each term). The teacher would start in their preferred arrangement, swap to the alternative, and then return to their preferred for the final term. Across these three terms, the teacher and students would engage in repeated measures, acting as their own baseline across the three terms, to see if any changes were evident across the furniture arrangements. In this type of quasi-experimental design, other variables need to be controlled as much as possible. For this project, each teacher and student participants remained the same across the three terms, the school's pedagogical approach remained consistent, the other features of the room remained the same (i.e., same physical space in terms of heat, light etc. as well as wall and ceiling displays). The only major change was the furniture arrangement, which was either "flexible" (characterized by having different seating surfaces, different desk and table heights, furniture that could be easily reconfigured) or "traditional" (defined by the teacher participants as being groups or rows of desks with hard-backed chairs and a floor mat).

The repeated measures across the terms consisted of:

- teacher observations. Once every three weeks, a random lesson (approximately 40 minutes) would be observed using Novum's Learning Environments Analysis Survey Application (LEASA);
- teacher interviews. Once a term, the teachers would have an individual interview with the LEaRN academics to unpack their observation data and reflect on the previous term;
- teacher mind frame survey. This survey was done pre- and post- the project as a measure of the incidence of high impact teaching strategies, as outlined by Hattie (2012);
- student survey. A short student engagement survey (behavioral and cognitive domains) was administered every three weeks;
- photo elicitation activity. When in the flexible arrangement, students took a photograph of where they were working every three weeks and annotated it to explain why they had chosen their furniture item/s.

A teacher was released to support the spatial learning team to do the observations, support the survey administration and collate the photo elicitation data. This teacher also supported some data analysis activities, as well as the dissemination of findings back to the school community.

### 3.2.2. The findings

After the first year of data collection, we found that 93% of students across Years 3-6 feel that furniture impacts their learning. They actively select furniture to meet their physical or learning needs, for example, sitting at a desk behind a word wall screen, so they would not get distracted by peers, or sitting at a high table because the higher surface meant they could stand or sit to manage back pain issues. The data showed that students had "resilient engagement" – one term of having different furniture wasn't enough to make any statistically significant difference to their engagement, but it did make a difference to the teachers. The school employed an inquiry-based approach to learning that was dynamic, collaborative and student-centered. When teachers could not make their intended activities work within the confines of the traditional furniture arrangement, they took their learning elsewhere, such as going outside. This difference in pedagogy was significant in the data. When working with flexible furniture, teachers employ more student-centered approaches, when working with traditional furniture they use more teacher-centered approaches. A Mann-Whitney U test showed this difference is significant at the .05 level: (ILE furniture: Mean Rank = 14.74, n = 23; Traditional furniture: Mean Rank = 21.00, n = 9), $U = 63.00$, $z = -1.70$, $p < .05$.

Teachers also reported higher mean scores on the teacher mind frames survey when teaching in spaces with flexible furniture. In particular, they find it easier to build relationships and trust with students in a space with flexible furniture as opposed to one with traditional furniture: (ILE furniture: Mean Rank = 9.64, n = 7; Traditional furniture: Mean Rank = 5.36, n = 7), $U = 9.50$, $z = -1.94$, $p = .05$. In terms of relationships, teachers also reported that they noticed more relationship issues among students in the traditional environments. While students could easily navigate around each other in the flexible space, tensions between students increased when they were sitting with the same people for most of the day in traditional groupings. Teachers had to manage students who did not want to be grouped together, or frustration at being apart from peers they would normally collaborate with. This workload was not evident in the flexible spaces where teachers gave students more autonomy in the way they moved and collaborated.

The data from this project was also beneficial to the industry partner, the furniture manufacturer. Analysis of the repeated photo elicitation activity built a bank of the types of furniture most frequently chosen by students and the characteristics that make those items useful. For example, the three most preferred items of furniture across year levels were: high tables with adjustable stools (17%), circular tables (16%) and soft seating (13%). Two main reasons students select their furniture is for comfort (54%) and flexibility (11%). Flexibility was defined by the students as allowing height adjustment for both seats and work surfaces, as well as writable surfaces and the ability for an item of furniture to be used for both individual and collaborative work; while comfort was mostly related to having soft seating and the ability for the furniture to help manage discomfort, such as the back-pain example. This information can give feedback into future designs by the

industry partner, showing them how students are using their furniture and the qualities that help them to choose where they work best.

In terms of engaging in research, the school made a significant commitment to release a teacher for a day per week to facilitate this complex research design. This strategy not only supported the data collection to run smoothly but allowed the LEaRN researchers and teacher to work closely to develop their research skills throughout the project. While the school were initially surprised (and perhaps disappointed) to see that there was no significant increase in engagement when working in a flexible environment, discussions between the spatial learning team and researchers have centered on developing a second year of activity to unpack the nature of engagement at the school in more depth, and the role furniture plays in keeping engagement high among their students and teachers.

## 4. Discussion

The range of P2P project outlined in the methods and the two case studies presented in our findings demonstrate that no two schools are the same in terms of their spatial issues and interests. However, there are some common themes that arise across all the projects. First, each school was driven by the need to build evidence. They need to know what is happening in their current pedagogical practices so that future ideas and strategies will be founded on data, and recognized that existing data linking spaces and teacher practices is limited (Blackmore et al., 2011; Cleveland & Fisher, 2014). For example, Sunshine School had put significant thinking into designing their student-centered, agentic curriculum approach and had an enthusiastic staff, but had no sense of how students were using space to realize their school's vision. To build these data, there is also a need for specialist support. Teachers and school leaders cannot do it all, and external specialists (researchers, architects, interior designers) can work effectively with schools to build evidence.

Second, each project and research partnership must recognize relevancy in terms of the school context. Just as there is no one definition of what makes an ILE (Mahat et al., 2018), there is also no universal solution to ILE issues. There may be commonly accepted solutions to spatial issues, but every change to the school environment must be examined through the lens of the school's unique structures, policies and teaching practices, as well as the school culture (Hofman et al., 2009). Yet, it is also positive when P2P findings have consistency with bigger data sets; for example, the greater incidence of high impact teaching practices in ILEs at Coolbardi Primary School is consistent with the Imms and colleagues (2017) sample of over 800 Australasian schools.

Third, as evidenced by Young and colleagues (2020), the teachers across the P2P projects have had an instinct for how classrooms work, built over their years of teaching practice. However, as school design continues to be updated through ILEs, teachers need support to transition to new spaces and new ways of teaching. They need time and space to reflect on how the space adds to their pedagogies, and how ILEs give students greater agency in their learning (Blackmore et al., 2011). P2P

provides the catalyst for teachers to reflect on their practice, and particularly for those involved in the spatial learning teams, the opportunity to bring their strengths to a co-design process in which they also develop research skills (Blannin et al., 2020; Whitehead & McNiff, 2006). This benefit is evident in the Coolbardi Primary School project, where a teacher had formal release from duties to engage in the professional learning from leading the research project within the school.

Fourth, the positive impact of ILEs is not just reserved for big, new builds. The same affordances and impact on learning can occur with much more modest reconfiguration of existing environments, for example, by changing furniture. Having a range of furniture to suit different activities and student preferences can support learning (Dudek, 2000; Imms et al., 2020; Saltmarsh et al., 2015) without being cost prohibitive to a school. Yet, as recognized by the OECD (2015), pedagogical changes must complement the environmental changes made for there to be positive impact on learning and for the environment to be considered innovative.

## Conclusions

The underlying message from the P2P schools is that ILEs are helping us to improve teaching and learning. However, for ILEs to work effectively, there needs to be some critical elements that P2P is highlighting, and that centers on teachers having a voice in ILE implementation and evaluation. There needs to be conversation between architects and educators to ensure a clear alignment between design and pedagogy, even before the school opens. There needs to be a clear vision for how learning will happen, a vision that is revisited consistently as other variables change in the school. There needs to be a staff who are open to re-thinking their pedagogies to make the most of design affordances – teachers who work collaboratively to develop the ways they can get the best out of their spaces and students. There needs to be support for spatial learning teams. Teachers' time is so valuable, so investing in the right small group of people who can lead the whole staff in terms of how space is used goes a long way to ensuring that spatial practices remain a core part of the business of schools. Finally, there needs to be access (internal or external) to good research skills. Each project must, in advance, think about the data that will answer the school's current spatial questions, and build to the next evaluation. These data must have the rigor to direct future thinking and experimentation in terms of ILEs and be disseminated clearly to the school community and wider educational audience.

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