

Learning Spaces literature review

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# The context

In an article for the OECD, Kenn Fisher ([2005](#_ENREF_15)) claimed that in examining the literature on the design of learning spaces there was insufficient qualitative and deep research on the relationship between pedagogy and design of learning environments. Fisher suggests that research should follow five key steps:

1. What student abilities do we want to achieve?
2. How can we assess these attributes?
3. What pedagogies should be used to achieve these desired learning outcomes?
4. What learning environments should be developed to fit these pedagogies?
5. How can we develop a pilot program and evaluate it?

In response to the first of Fisher’s questions it is widely recognised that early in the 21st Century we face a number of challenges or change imperatives that are significant now and in the medium to longer term. These are social, economic, technological/scientific, health and ecological challenges. ACARA has identified seven General Capabilities necessary to address these: Literacy, Numeracy, Information and communication technology capability, critical and creative thinking, personal and social capability, ethical understanding, intercultural understanding ([ACARA, 2013](#_ENREF_1)).

In response to Fisher’s second question, the general capabilities can be assessed using rubrics based on taxonomies such as Bloom’s taxonomy or the SOLO taxonomy. These taxonomies involve a set of criteria for evaluating the quality of a response to (or outcome of) a task. The quality (or richness or complexity) of a response to a complex task varies with the relevance of the considerations brought to bear on the task, the range or plurality of those considerations, and the extent to which these considerations are integrated into a whole, and extended into broader contexts to create something new.

Work is in progress to respond to the fifth question, some preliminary findings of which are provided in this paper.

The purpose of this paper is to explore the answer to Fisher’s fourth question.

## The focus on learning spaces

Imms, Cleveland and Fisher ([2016](#_ENREF_20)) found that schools are altering their architecture and spatial arrangements from the traditional corridor and classroom layout to more ‘flexible’ school designs to reflect 21st century approaches to teaching and learning. Our own research in 15 New South Wales government schools is consistent with these observations.

The idea of schools as the architectural embodiments of educational philosophies that inform students and teachers about how they should behave through the provision of an environmental ‘script’ is conveyed in Monahan’s notion of “built pedagogies” ([see Cleveland, 2016](#_ENREF_7)).

## Guiding question 1: What is an innovative learning environment?

Innovative learning environments have also been referred to as Modern Learning Environments ([Bradbeer, 2015](#_ENREF_5)), new learning spaces ([Hall, 2013](#_ENREF_18)) and new generation learning environments ([Imms et al., 2016](#_ENREF_20)). These are characterised by polycentric room designs, infused information and communication technologies, movable walls and other agile interior elements, ‘student friendly’ furniture and ready access to resources ([Imms et al., 2016](#_ENREF_20)). In tertiary settings, these may also include larger spaces for 60 – 100 students with features such as tiered seating that easily modify to enable students to gather in groups throughout the lecture, as well as rooms with circular or triangular pods without a clearly defined front with screens surrounding the room facing different directions ([Hall, 2013](#_ENREF_18)).

 A broader understanding of these spaces can be understood as:

* Learner-centred: focus of all activities,
* Structured and well designed: role of teachers in supporting inquiry and autonomous learning,
* Profoundly personalized: sensitive to individual and group differences in terms of background, prior knowledge, motivation and abilities,
* Inclusive: sensitive to individual and group differences in terms of learning needs,
* Social: learning most effective when cooperative and in-group settings ([Blackmore, Bateman, O'Mara, & Loughlin, 2011, p. 18](#_ENREF_4)).

They are typically team teaching environments with increased student autonomy – designed to enable them to develop the skills and competencies to participate successfully in a globalised knowledge economy, through teamwork, knowledge sharing and creativity ([Chapman, Randell-Moon, Campbell, & Drew, 2014](#_ENREF_6)). Students are increasingly required to take responsibility for their own learning and teachers are becoming the curators of learning experiences, that range from whole class didactic encounters, through collaborative peer-peer active learning to reflective one-on-one consultations with students ([Imms et al., 2016, p.3](#_ENREF_20)). Learning spaces can be understood as *complex adaptive assemblages* ([Dovey & Fisher, 2014](#_ENREF_14)); this term highlights the importance of understanding how different kinds of pedagogies are facilitated by these spaces.

A variety of spatial typologies is now emerging. Dovey and Fisher (2014) summarise these into five genres of design, ranging from the traditional egg-crate style, through to large open space configurations.

Although openness increases across the typologies the experienced educator often comments that maximum flexibility occurs in types C and D where walls, doors, furniture and spaces can be (re)configured to support a wide array of desired learning and teaching practices, activities and behaviours.



*Figure 1. Dovey and Fisher’s learning space typologies (2014), adapted by Soccio & Cleveland, 2015*

The more flexible spaces can be opened up into a large space if desired and the bi-folding walls can be closed to create smaller learning spaces. Because of an absence of bi-folding walls the Type E space cannot easily be differentiated into smaller spaces if needed. Much of the literature on innovative learning spaces refers to them as open spaces synonymously. We caution against the synonymous use of these terms, as will be explored in the following section. Non-standard learning spaces are not new. The 80s saw an interest in the development of open-plan schools. These experiments ultimately failed because open plans often confused flexibility with openness ([Dovey & Fisher, 2014](#_ENREF_14)).

These learning spaces can be arranged differently to constitute “neighbourhoods” such as the case in three schools in Bendigo, Victoria ([Cox & Edwards, 2014](#_ENREF_11)). Neighbourhoods were constituted by a collection of central green spaces, a breakout space (Einstein Studio) a shared Arts/Science learning space (Da Vinci Art & Science Studio) and an enclosed teaching area with AV facilities (Socratic Studio). Such spatial arrangements also require particular arrangements of school-level grade structures, pedagogy, timetabling, curriculum, and teacher and student roles and practices. These are considerations which will be covered later in this paper.

The increasing variety of learning spaces being made available to teachers means that in order to be able to make good use of these spaces for learning, teachers are required to acquire a new type of literacy: spatial literacy ([Imms et al., 2016](#_ENREF_20)). This form of “environmental competence” means the ability to understand space as a pedagogical tool, a competence that has been found to be lacking in many educators ([Cleveland & Fisher, 2014](#_ENREF_8)).

If teachers are to be able to work effectively in these new environments, they need spatial literacy skills for “spatialised pedagogic practice” – to use learning spaces to achieve the best pedagogical effect ([Cleveland, Soccio, & Love, 2016](#_ENREF_10)).

Classroom design should demonstrate adaptability and flexibility. Furthermore, such design should emphasise stimulating, adaptable learning environments, with spaces to support various styles of teaching and learning. Pedagogical and physical structures need to be remodelled in parallel ([Robinson & Robinson, 2009](#_ENREF_29)).

This paper focuses on the innovative learning environments at the classroom level and as they relate to the work of the classroom teacher. Yet Bernard ([2012](#_ENREF_3)) reminds us that whilst the classroom or learning space at the centre of all learning activity is embedded in the physical and organisational climate of the school, the community and the broader social and cultural context.



*Figure 2. Areas of impact on the quality of learning environments by level (*[*Bernard, 2012*](#_ENREF_3)*).*

Each of these concentric circles has a different level of control over its physical, organisational and pedagogical environment. Teachers are only able to exert control of their classroom space; it is the role and responsibility of the school and broader system to provide appropriate resources and legitimise teacher agency into the structures that support their work.

## Guiding question 2: What are the benefits of innovative learning environments?

ILEs enable a repertoire of pedagogies and the development of a range of capabilities and future-focused skills.

Innovative learning environments have been found to have benefits beyond academics. In the study of three open-plan schools arranged in cross-grade “neighbourhoods” with varied and differentiated learning spaces, a range of improvements were found. These included improvements in wellbeing, peer support from different-aged peers, opportunities for leadership, increased autonomy and new relationships between students and teachers. The mixed structure allowed for personalisation of learning ([Cox & Edwards, 2014](#_ENREF_11)).

Studies have demonstrated the benefit Innovative Learning Environments to student engagement ([Cleveland, 2016](#_ENREF_7)). Building on the notion of engagement by Fredricks, Blumenfeld and Paris: behavioural, emotional (affective), and cognitive, the authors later added to this the idea of geographical engagement. This is fostered by spaces that:

* Afford opportunities for students to engage in a diverse range of activities/pedagogical encounters
* Afford opportunities for flexible grouping arrangements that offered students regular transition between working on their own and as members of variously sized groups
* Provide students with access to a variety of learning resources and materials including ICT

It is suggested that the successful demonstration of students as self-directed learners appeared to be correlated with their level of geographical engagement. These spaces are contrasted to traditional learning spaces, below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Dimension** |  |  |  |  |  | **Source and comments** |
| **Space** | Traditional |  |  |  | ILEs |  |
| **Delivery** | Homogenous |  | Individualised |  | Personalised |  |
| **User focus** | Teacher-centred |  |  |  | Student-centred |  |
| **Directedness** | Discipline |  |  |  | Autonomy | Monahan |
| **Freedom** | ComplianceConformity |  |  |  | CreativityAgency |  |
| **Outcome** | Assimilation |  |  |  | Individuality | Modified from Page et al |
| **Pedagogy** | TransmissiveDidactic |  |  |  | ConstructivistInquiry-based | Page et al |
| **Modifiability** | Unresponsive |  | Flexible |  | Reflexive | Modified from Cleveland 2016 |
| **Technology use** |  | Substitution | Augmentation | Modification | Redefinition | Inspired by SAMR; doesn’t follow strict continuum |

*Table 1. The characteristics of different learning spaces.*

# The main focus

## Guiding question 3: What will help me to teach successfully in an innovative learning environment?

### Identifying and employing the affordances of ILEs as a tool to enable my repertoire of pedagogies

ILEs should be imagined as tools to support the pedagogy being used to achieve the learning outcome for the lesson, just as technology is understood as a tool which acts in the same way. The SAMR model has been developed to help teachers understand how they can use technology to support their learning goals; moving from the use of technology as an enhancement of a task to its transformation ([Puentedura, 2006](#_ENREF_28)). A heuristic based on the SAMR model of technology could be developed for teachers to understand the use of ILEs to achieve their learning goals. In much the same way that technology should be used in transformative ways, learning spaces, too, should be used in these ways. The SAMR model has been adapted reflect its application to learning spaces, below.

|  |  |
| --- | --- |
| Transformation | Redefinition: the learning space allows for the creation of new learning activities, previously inconceivable |
| Modification: the learning space allows for significant learning activity redesign |
| Enhancement | Augmentation: the learning space is used as a substitute, with functional improvement to the learning activity |
| Substitution: the learning space is used as a substitute, with no functional change to the learning activity |

*Table 2. SAMR adapted to learning spaces. Adapted by Liliana Ructtinger from:* [*http://hippasus.com/blog/wp-content/uploads/2016/05/SAMRAndSustainability.pdf*](http://hippasus.com/blog/wp-content/uploads/2016/05/SAMRAndSustainability.pdf)

Understanding how space can be used in transformative ways requires an understanding of the affordances of different spaces and how they relate to pedagogy. Dovey and Fisher ([2014](#_ENREF_14)) suggest a typology of pedagogies for this purpose.

|  |  |
| --- | --- |
| Presentation25-150 students | Students or teachers present to a largely passive group. Group size may vary from one class cohort to a full form or year. Such activities facilitate efficient communication of information. |
| Large interactive 25-75 students | Activities that move seamlessly from large to small group and back; often organized in sub-groups of 4-6 that can be subdivided again into 2s or 3s. Facilitates peer-to-peer learning and team teaching. |
| Medium interactive 10-25 students | Activities with a similar flow of movement to the above, but with a smaller group size and generally one teacher. |
| Creative interactive 10-25 students | Interactive activities but with an emphasis on hands-on learning in addition to pens and keyboards, plus access to a range of resources that may include art materials, wet areas, laboratory or outdoors. |
| Small interactive 2-5 students | This is the ‘breakout’ model of problem-based and peer-to-peer learning with small autonomous groups that may disperse and take responsibility for their learning. |
| Reflection 1 student | Singular activities that include reading, writing or hands-on research to meet learning objectives.  |

*Table 3. Typology of general pedagogies (*[*Dovey & Fisher, 2014*](#_ENREF_14)*)*

Dovey and Fisher note that in everyday contexts these varied pedagogical practices rapidly and frequently morph into each other as groups form and dissolve; segment and amalgamate. Didactic teaching (as presentation) remains part of this mix but is reduced to a small portion of the total time. They do not give examples of these pedagogies; as such we discuss examples, below.

An example of a small interactive pedagogy is Project Based Learning. Hewes and Hewes note that during Project Based Learning “students may work individually or in a small team, depending on the nature of the project. The ideal team size is four students, as this allows every student to have an opportunity to contribute meaningfully to project work.” ([Hewes & Hewes, 2016, p. 1](#_ENREF_19))Hewes and Hewes also note “There will be times where you will teach in a more traditional teacher-centred style, especially when you are introducing project requirements or instructing the whole class on important content or skills.” ([Hewes & Hewes, 2016, p. 1](#_ENREF_19)). Thus there is an element of presentation in Project Based Learning – implicitly to a whole class (around 25 students).

Project Based Learning can be taught as a large interactive pedagogy. At one primary school in Sydney Years 4,5 and 6 are in a large open space. There are 95 children. The teachers teach collaboratively – but not in a traditional way with a chair for each students and a table between two. The school’s classrooms have less furniture – not all children have a table and a chair. Resources are shared. The Principal considers that with more students and more adults it is easier to facilitate pedagogies such as Project Based Learning.

The success of Project Based Learning in such environments depends on the difficult matter of acoustics, and smooth transition of students into different size groups.

An example of a medium interactive pedagogy is Socratic Pedagogy. The approach is based on a ‘community of inquiry’ in which children learn critical thinking by working with one another and building on each other’s ideas, questioning each other’s underlying assumptions, and suggesting alternatives. Although a Community of Inquiry can involve up to 30 participants, with such a large group it is difficult to encourage all participants to participate verbally *and as equals.* With a group of this size, to encourage more equal participation it may be necessary to break the group up by adopting a think-pair-share approach. On the other hand if a Community of Inquiry is too small it may lack sufficient diversity of perspectives to encourage dialogue. Experienced practitioners suggest that an ideal size for a community of inquiry is around 15. A community of inquiry would not be feasible for group sizes of over 30.

An example of a Creative Interactive Pedagogy is Learning-by-design. Learning-by-design is a science learning program in which students design and create an artefact such as a robot. Learning-by-design involves the idea that children learn deeply when they are asked to design and create an artefact. The complexity of the work often dictates the need for collaboration and distributed expertise. A variety of valued cognitive tasks are employed such as setting constraints, generating ideas, prototyping, and planning through “storyboarding” or other representational practices. This pedagogy includes the programming and development of modelling and robotics products.

An example of a Large Interactive Pedagogy is think-pair-share. This pedagogy is often used in lectures. Teachers begin by asking a specific question e.g. about a text. Students think about a possible answer to the question. Each student is paired with another student or a small group. Students share their thinking with their partner(s). Teachers invite students to share in a whole group discussion. Think-pair-share can be used for smaller groups too. Think-pair-share does not require any rearrangement of furniture. Students could sit in one seat for the entire duration of the class.

An example of a Reflection Pedagogy is a metacognitive pedagogy such as IMPROVE. Metacognition is the ability for students to plan, monitor, control and reflect on their work. This kind of approach is used in relation to solving complex, unfamiliar and non-routine (CUN) problems; which are becoming increasingly important in innovation-driven societies ([OECD, 2014](#_ENREF_26)). They key element of IMPROVE is four types of self-directed metacognitive questioning that are about task comprehension (what is the problem about?); content connections (explain how the problem is similar or different to others?); strategic questioning (explain what the appropriate strategies for solving the problem are); and reflection (does the solution make sense? can it be solved differently? am I stuck?). Substantial evidence has been cited in relation to the use of metacognitive strategies ([OECD, 2014](#_ENREF_26)). Cooperative settings appear to be best suited to teaching metacognitive strategies, although this finding is variable.

A large interactive pedagogy would be best suited to types C, D and E, since large open spaces are available in these designs. Small and medium interactive pedagogies are by definition not suited to large numbers of students. A number of small to medium sized groups could simultaneously be conducted in a large open space, facilitated by three or four collaborating teachers. Acoustics and furniture arrangements could be a difficulty, the latter if groups form and dissolve throughout the lesson. Small to medium groups are better located in break out rooms.

Creative interactive pedagogies often require specialised spaces such as art rooms, science laboratories or 3D printers. These are the sorts of rooms that are exemplified by the Socratic Studio, Da Vinci Studio and Einstein Areas which constitute neighbourhoods at Grevillea College, VIC ([Cox & Edwards, 2014](#_ENREF_11); [Deed, 2015](#_ENREF_13)).

Preliminary evaluation findings from a project undertaken in Victoria called *Towards Effective Learning Environments in Catholic Schools: An Evidence Based Approach (TELE)* of 12 school environments found that some learning environments typologies were found to be more supportive of certain encounters than others. Small group work was identified as challenging in type A and B learning environments, while whole class work was identified as challenging in type E learning environments ([Cleveland et al., 2016](#_ENREF_10)). The degree of challenge of small group work in Types A and B learning environments may depend on the arrangement of furniture in these spaces (see below).

Dovey and Fisher ([2014](#_ENREF_14)) distinguish between two kinds of flexibility: the reversible convertibility from traditional to constructivist pedagogies and back; and fluidity the ways the building enables flexible flows from one activity type to another within the constructivist pedagogy. We challenge Dovey and Fisher’s characterisation of convertibility. The inflexibility of Type E “dedicated commons” is not a lack of convertibility from traditional to constructivist pedagogies and back. Both traditional and large interactive pedagogies can be implemented in the large spaces that characterise Type E. Rather Type E privileges large interactive and presentations but constrains small, medium and creative interactive pedagogies.

Dovey and Fisher state that “The traditional plans and dedicated commons are less adaptable in this sense than convertible types since the closed classroom constrains new pedagogies and the open plan constrains traditional teaching” Not so. Closed classrooms constrain large interactive pedagogies but not small or medium interactive pedagogies (provided the closed classrooms are flexibly furnished). Open plans do not constrain direct instruction but small to medium interactive pedagogies.

The most open of plans are often not the most adaptable because they constrain choice. In this sense fluidity is an adaptive condition produced by a conjunction of openness and closure ([Dovey & Fisher, 2014](#_ENREF_14)). Open spaces need to be structured in ways that are able to communicate behavioural norms ([Watkins, 2017](#_ENREF_32)).

Futurist David Thornburg identifies three archetypal learning spaces – the campfire, cave, and watering hole – that schools can use as physical spaces and virtual spaces for student and adult learning ([Davis & Kappler-Hewitt, 2013, p.25](#_ENREF_12)).

The **campfire** is a space where people gather to learn from an expert and suits more teacher centred and explicit instruction. The experts are not only teachers and guest speakers, but also students who are empowered to share their learning with peers and other teachers.

The **watering hole** is an informal space where people can share information and discoveries, acting as both learner and teacher simultaneously. This shared space can serve as an incubator for ideas and can promote a sense of shared culture. This sort of space supports inquiry based approaches.

The **cave** is a private space where an individual can think, reflect, and transform learning from external knowledge to internal belief. It also acknowledges the need for privacy and to be by ourselves sometimes. Most learners need some time to themselves, and some need more time alone than others.

With flexible furnishings, e.g. chairs and tables that can be readily moved around the room or up and down, a campfire can be transformed into a watering hole, or into a series of caves.

We would add other metaphors to Thornburg’s by including:

The **sand pit** for creative interactive pedagogies with access to art materials, wet areas, laboratory or outdoors,

The **yarning circle,** a seating arrangement for a community of inquiry, and

The **amphitheatre,** a seating arrangement for a large presentation.

Furniture arrangements that best support learning using a variety of pedagogical and assessment approaches should be:

1. Varied – different types of learning spaces throughout the school, to support varied pedagogical and assessment approaches – and to support different learning needs of students ([Davis & Kappler-Hewitt, 2013](#_ENREF_12)),
2. Integrated – technology needed to support pedagogies should be integrated into the learning space to encourage learning by doing ([Fisher, 2010](#_ENREF_16)),
3. Flexible – e.g. furniture can be rearranged to create different kinds of learning spaces at different times. An amphitheatre is a flexible space that can be pulled apart. It can be used to show a PowerPoint presentation, for school development, professional development. It can be used for presentations – direct instruction – but it can be re-arranged to serve as a simulation of parliament. It is helpful if all furniture at the school is height adjustable, so it can be used for children and adults. It should be easy to change height – lift up and drop pins. It should be easy for furniture to be moved around, e.g. on casters. Stacking chairs saves space.

One step beyond flexibility is “reflexivity”. Where flexible is widely used by educators and architects to describe spaces that are intended to cater to a variety of learning experiences, reflexive spaces are “physical environments that both inform pedagogical encounters and are informed by pedagogical encounters via a bi-directional relationship between the physical environment and inhabitants” ([Cleveland, 2016, p.45](#_ENREF_7)).

Cleveland ([2016](#_ENREF_7)) suggests that flexible spaces do not inform teachers and students about how they might engage in particular learning activities, whereas reflexive spaces do suggest how users might participate in activities, while still enabling them to fine tune physical settings to meet their pedagogical needs. They encourage a range of pedagogical encounters by providing environmental cues that support their mastery of its use.

The hybrid model of social learning proposes that learning occurs by doing, and specifically that skill acquisition is a combination of information from the social world (such as learning from others) and from the physical-biological environment ([Sterelny, 2012](#_ENREF_31)). The physical-biological environment is considered to be “seeded” with informational resources such as raw materials, full and partial templates of products and tools.

A reflexive learning space is similarly “seeded” with suggested uses and affordances of the space – the “environmental cues” (e.g. furniture arrangements) that Cleveland suggests. It does not constrain or direct the pedagogy that should be employed within the space, but it suggests ways that the space could be used to a teacher’s advantage to achieve the pedagogy that they decide to be most appropriate for their learning aims.

Sterelny ([2012](#_ENREF_31)) agrees with the Vygotskyan notion of the Zone of Proximal Development – whereby there is the intentional guidance and assignment of tasks up to, but not beyond student’s skill ceiling. The use of the tools in the seeded learning environment are part of this guided learning. It has been found that users of innovative learning environments also need support in knowing how best to make use of the tools in this seeded learning space; students and teachers alike ([Chapman et al., 2014](#_ENREF_6); [Cleveland, 2016](#_ENREF_7)).

In traditional, standardised teaching environments, the role of the spatial (e.g. flexible use of space) was minimised, since the range of teaching spaces were standard and therefore functioned as a constant, rather than a variable open to manipulation. The range of pedagogies, was similarly limited, typically to didactic and transmissive pedagogies, although other pedagogies were certainly known to teachers.

Teachers might be called upon to adapt their pedagogy to suit the cheaper open plans, resulting in challenging acoustics and furniture arrangements. Thus the learning space drives the pedagogy rather than the pedagogy driving the learning space – a situation to be avoided.

While it is not the case that other pedagogies are not employed by teachers in traditional spaces, the effect of the spatial constrains their ability to deploy these pedagogies with equal ease, acting as barriers and as “pedagogically-irrelevant factors” which hinder, rather than facilitate their ability to teach according to the pedagogy best suited to the learning goals and needs of the students.

The notion of pedagogically-irrelevant factors draws on the Evidence-Centred Design literature for assessment design which has as one of its aims the identification, reduction or at least acknowledgement of the presence of factors which counter the assessment aims of an activity or setting ([Haertel et al., 2016](#_ENREF_17)). In much the same way that the interpretation of evidence of what a student knows and can do can be invalidated by the presence of requirements of a task that are outside the focus of the knowledge skill or ability being assessed ([Mislevy et al., 2013](#_ENREF_24)), learning spaces, too, can result in suboptimal learning outcomes due to irrelevant exigencies on the students attention, physical abilities and available resources which shift the focus of the activity to actions that do not relate to the learning goal. These exigencies can manifest as pedagogically-irrelevant factors, such as inadequate sound insulation, resulting in extraneous noise ([Mealings, Buchholz, Demuth, & Dillon, 2015](#_ENREF_22))

Below we present a consolidation of the thinking about general pedagogies and their suitability for different space types, as described by Dovey and Fisher, specific pedagogies, and furniture arrangements inspired by the work of futurist David Thornburg on archetypal spaces:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| General pedagogy | Description | Group size | Specific pedagogies | Space type | Archetypal furniture arrangements |
| Presentation | Students or teachers present to a largely passive group. Group size may vary from one class cohort to a full form or year. Such activities facilitate efficient communication of information. | Vary | Direct Instruction | A, B, C, D, E | Campfire > Amphitheatre(small > large groups) |
| Large Interactive | Activities that move seamlessly from large to small group and back; often organized in sub-groups of 4-6 that can be subdivided again into 2s or 3s. Facilitates peer-to-peer learning and team teaching. | 25-75 students15 groups of 525 groups of 3 | Collaborative teachingThink, Pair, Share | C, D, E | Campfire > Watering hole > campfire |
| Medium interactive | Activities with a similar flow of movement to the above, but with a smaller group size and generally one teacher. | 10-25 students | Community of Inquiry | A, B, C, D, *E?* | Yarning circle |
| Creative interactive | Interactive activities but with an emphasis on hands-on learning in addition to pens and keyboards, plus access to a range of resources that may include art materials, wet areas, laboratory or outdoors. | 10-25 students | Learning by Design | A, B, C, D, *E?* | Sandpit |
| Small interactive | This is the ‘breakout’ model of problem-based and peer-to-peer learning with small autonomous groups that may disperse and take responsibility for their learning. | 2-5 students | Project Based Learning | A, B, C, D, *E?* | Watering hole |
| Reflection | Singular activities that include reading, writing or hands-on research to meet learning objectives. | 1 | Personalised learningIMPROVE | A, B, C, D, E | Cave |

*Table 4. The types of learning spaces and physical arrangements that can support different pedagogies.*

### knowing my students: accessibility needs, behaviour management

There are significant considerations for students with disabilities.

ILEs are well situated to implement Universal Design for Learning (UDL) principles. These principles are intended to guide the design of learning activities and resources to suit all learners, including those with disabilities. The three UDL principles are to provide multiple means of:

* *representation* to give learners various ways of acquiring information and knowledge,
* *action and expression* to provide learners alternatives for demonstrating what they know, and
* *engagement* to tap into learners' interests, challenge them appropriately, and motivate them to learn ([Meyer, Rose, & Gordon, 2016](#_ENREF_23)).

A study examined the acoustics of a mid-range open plan Kindergarten classroom containing 91 students, compared to an enclosed classroom of 25 students ([Mealings et al., 2015](#_ENREF_22)). The results revealed much higher intrusive noise levels in the open plan classroom, resulting in signal-to-noise ratios and speech transmission index scores to be well below those recommended in classrooms with students of this age.

The authors note that children spend 45-60% of their time at school listening and comprehending, so they need to be able to discriminate the speech signal from the competing noises present in the classroom environment. High noise levels result in poor signal-to-noise ratios. High noise levels adversely affect speech perception, cognition, concentration, and the psycho-educational and psychosocial achievement of the child. Children with hearing impairments, and/or those who have English as a second language, are even more affected by poor classroom acoustics.

While only 5% of the general population experience vocal fatigue, 80% of teachers experience it, putting them at high risk of pathological voice conditions from the need to constantly raise their voice above a comfortable level to be heard . Noise also raises blood pressure, increases stress levels, causes headaches, and results in fatigue.

The authors claim that these results demonstrate the benefit of having acoustic barriers (i.e. bi-folding walls) between classes to minimize the transmission of intrusive noise from adjacent classes – characteristic of spatial types C and D but not E.

Research into the nature of inclusive education in innovative learning environments found that ILEs tended to have the following benefits to students with a range of physical, cognitive and social disabilities:

* accessible buildings for students with physical disabilities
* smooth student transitions from one segment of the building to the other
* enhanced socialisation and collaboration is enhanced through group work
* integrated technology overcoming issues of access, learning, communication, independence, mobility and social goals
* multi-level classes useful for combining students with similar needs/abilities
* teachers able to circulate more freely between students

Drawbacks to students with disabilities included:

* ensuring teachers adapt their practice and evaluate it
* learners are required to exercise an extensive degree of self-regulation
* the challenge of working in groups may be particularly acute for children with autism
* sensory overload, particularly for children with autism
* hearing challenges for hearing impaired, with high intrusive noise levels negatively impacting speech perception ([Page & Davis, 2016](#_ENREF_27)).

We would argue that many of these benefits and drawbacks are not inherently linked to the spaces themselves, but rather the practices that are supported or elicited by such spaces and by the school policies and organisational culture. The physical environment should be designed with well sound-insulated and differentiated spaces that are physically accessible and provide different options for access to technology and learning resources.

Beyond the physical and material elements required for supporting a range of student needs, other practices include implementing UDL principles, personalisation, employing a range of pedagogies, including constructivist, metacognitive and inquiry-based pedagogies, teachers evaluating their practice as part of regular teaching, and fostering a caring, supportive and inclusive school culture in which “no pupil is excluded”. This is exemplified in successful case studies presented by Page and Davis, including the Jenaplan school in Germany which uses mixed-age classes (enabled by ILEs) and the Analucia school in Spain had all staff and students learn sign language and training on the use of ILEs and inclusive education principles ([2016](#_ENREF_27)).

Behaviour management in innovative learning environments can be approached by understanding that certain aspects of space can be thought of as non-human didactics that equip the body with skills that have application to the social order requirements related to cohabiting and sharing of social spaces ([Watkins, 2017](#_ENREF_32)). An example provided by this researcher is the use of playground markings to communicate expected behaviour and organisation. Space therefore has the potential to communicate behavioural and social norms which can address behavioural needs if it is used intentionally such as employing archetypal furniture arrangements discussed earlier.

The increased recognition of the relationship between space and pedagogy has elevated the discourse to the mainstream. As teachers engage in these discourses and also make use of ILEs, they should be aware of how these new spaces result in particular arrangements of bodies, of social ordering and particular forms of conformity and curtailing of freedom ([Watkins, 2017](#_ENREF_32)). One example of the way in which this might manifest is discussed in the case study of a school structured in an open-plan setting with 90 students, subdivided into smaller groups that were required to communicate their progress on the learning task to teachers through the insidious use of smileys ([Benade, 2016](#_ENREF_2)). These practices of (self)surveillance can be understood in the context of the neoliberal discourses of individual responsibility and should not necessarily to be accepted uncritically in the classroom – teachers should instead consider how these practices lead to particular student subjectivities and how they may shape students in ways that prime them for a life of work.

As suggested by Chapman and colleagues ([2014](#_ENREF_6)), teachers should consider Henri Lefebvre’s claim: “space as a whole enters into the modernized mode of capitalist production: it is utilized to produce surplus value” and how this relates to the role of schools in the constitution, production and governance of the knowledge society.

### planning, timetabling, sharing spaces

Studies have found that the ways in which teachers conceptualise and operationalise notions of “structure” is key to the responsiveness of pedagogic approaches within open-plan spaces ([Saltmarsh, Chapman, Campbell, & Drew, 2014](#_ENREF_30)). Structure in this sense refer to the ways that teachers understood pedagogy as an activity that is or ought to be ordered, organised and conducted in particular ways. Teaching and learning is work, and depends on a division (or combination) of labour between teachers and students. To some extent structure is necessary to teaching and learning. Good teaching and learning depends on flexibility within this structure, to allow for a change of direction in a lesson, from a planned one. Where teachers are expected to facilitate interactive pedagogies with 90+ students, it is likely, to avoid chaos, they will need to ensure that the planning errs on the side of being too structured, than not sufficiently structured. With smaller groups there is more scope for flexibility.

Researchers emphasise the importance of teacher agency in innovative learning environments. Further study on one of the schools demonstrated that the process of teacher adaptation and exercise of agency in open-plan learning communities has the following characteristics:

* The abstract nature of open-plan learning environments affords a number of possibilities that must be balanced with the day-to-day routines of school-based teaching
* Teacher adaptation is a personally and collectively contested process, shaped by larger agendas of school and social change
* Adaptation refers to taking control over an experience through an intense (practical) inquiry process
* Balancing routine with difference
* Based on their practical knowledge about what works
* Critically interacting with diverse perspectives
* Collective knowledge base ([Deed, 2015](#_ENREF_13))

An evaluation of the School Spaces Evaluation Instrument (SSEI) investigated the alignment of pedagogy and learning environments, the focus of one of the instrument’s modules. Across the five schools that participated in the trial, the most common pedagogical/social issue that was found was that the large common area was underutilised. Relatedly, the number one spatial/physical issue of these large common areas was that the differentiation of activity settings was limited. All but one school cited these as problems ([Cleveland & Soccio, 2015](#_ENREF_9)).

Another paper found that challenges to undifferentiated large spaces include:

* Even though spaces had changed, pedagogical and cultural change took time and was difficult to implement Poor acoustic design was a big problem
* These spaces resulted in behavioural confusion where students didn’t know how to behave, not being able to recognise the behaviour settings, and teachers were seeking the “front” of the room

To overcome these challenges it was found that:

* Teachers integrated discussions about the use of space explicitly into their instruction which was seen to develop a sort of environmental competency in which students and teachers understand how best to make use of the space for learning
* Longer lessons were implemented at the school so that the class had longer to settle into the space
* Teachers required professional learning to adopt to constructivist pedagogies that were better suited to the new spaces
* Teachers needed to release control over student geographies, allowing students more autonomy in the space

The researcher also highlighted that schools need to ensure that teachers and students are able to form place attachment by being able to spend a sufficient amount of time in the space ([Cleveland, 2016](#_ENREF_7)). Sharing spaces in which groups of students spend tokenistic amounts of time in the space will be ineffective.

Another study found that whole class work was found can be difficult to support in all of the learning space types typified by Dovey and Fisher ([2014](#_ENREF_14)), relative to the other types of encounters ([Cleveland et al., 2016](#_ENREF_10)). The following variables were found to influence small group work in the learning environment:

* The number of students in the class;
* The amount of usable floor area;
* The allowable distance between small groups;
* The amount and layout of the furniture;
* The agility and re-configurability of the furniture; and
* Visibility and sightlines between adjoining learning spaces.

Furthermore, this study found that the following variables were found to influence teachers’ facilitating whole class activities in the learning environment:

* The nature of the whole class activity;
* The ability to open-up and/or close-down the learning space to match the activity;
* The ability to move to ‘another’ learning space more conducive to whole class activities;
* The noise levels for students participating in the activity;
* The noise levels generated by the activity (that may disturb others); and
* The quantity and layout of the furniture.

In relation to open-place (or type E spaces) in particular it has been observed that the relationship between space and pedagogy should not be understood as a simple linear causality and conceptually-sensitive adaptation to openness; we are instead encouraged to appreciate the following crucial mediating factors:

* use of different and experimental pedagogy
* increased student agency,
* distributed expertise,
* interdisciplinary and team teaching
* variable class sizes,
* the use of informal and irregular space and
* time available for learning ([Deed, 2015](#_ENREF_13)).

### collaborative teaching practice

The trend of professional learning communities in schools have been associated with two distinct drivers: a move from isolated to collegial teaching practices and changes in school learning spaces (both physical and virtual) that make teaching more public ([Deed, 2015](#_ENREF_13)).

ILEs are considered to suit team teaching, particularly the spaces exhibiting more open plans. Research on the adoption of ILEs in New Zealand discussed the way in which team teaching or teacher collaboration manifests in these spaces ([Bradbeer, 2015](#_ENREF_5)). Collaboration can end up being co-opted in an attempt to produce “contrived collegiality” and coordination.

This research adopted a framework of proximity proposed by Knoben & Oerlemans (2006) to interpret the findings from a set of interview with schools implementing ILEs. This framework recognises both spatial and non-spatial forms of proximity.

**Geographical proximity**or spatial ‘closeness’ is relevant to understanding how locality and relative distance intersects with space, deprivitisation, as well as planned and serendipitous interactions.

**Organisational proximity** refers to the systems and structures that underpin teacher collaboration; characteristics of rules, routines and behaviours.

**Relational proximity**describes social interactions and provides room to explore issues of power, participation, mutuality, and belonging.

**Cognitive proximity**is based on understanding shared routines, cultures, values and ways of working, which can be used to investigate norms, rationales and teacher mindset around collaboration. *Cognitive proximity may be better thought of as cultural, values, philosophical or conceptual proximity.*

**Technological proximity** describes mediating technologies used in the creation of new knowledge, and can be used to frame understandings of what and how teachers learn from each other.

The greatest concerns raised during interviews related to the co-construction of the relational technological and organisational elements – not the spatial concerns. These findings suggest that teacher professional development should focus on establishing the relational, technological and organisational practices that will enable use of ILEs.

 A study examined the benefits and challenges for teachers in a senior secondary college that had purposefully been designed to accommodate mixed classes of students ranging from small groups to up to 150 students and teachers working in pairs ([Lancaster, Cooper, & Corrigan, 2014](#_ENREF_21)).

The study highlighted relational as well as structural considerations. A major focus for teachers was the importance of working with a team partner who was “easy to get along with”, “likeminded”, “on the same page” or “a similar teaching approach or philosophy” or “being in tune” and shared common approaches to lesson planning with strong pedagogical content knowledge. Teachers also benefited from working with peers who were different in their teaching style, so as to avoid a homogenous learning experience.

The advantages of having a second teacher to allow the class to divide into smaller groups with the potential for differentiated instruction - allowed a teacher to attend to the questions and needs of individual students or to follow up on record-keeping tasks while the majority of class instruction was maintained by the other teacher. Providing differentiated instruction in multiple groups is therefore a major benefit.

Teachers are able to work in groups on different topics to cater for extension or catchup work using different teachers. The space also enabled the opportunity to promote rich debate and discussion in the classroom – of taking opposing views to model and encourage opinion, debate and a “multiplicity of perspectives”.

From a professional learning point of view teachers seeing other teachers teach and being part of this buzzing professional organization provides an opportunity for teacher mentoring to be fostered within teams. Intrinsic support is available when working in teams in that teachers are able to cover for each other during absences or illnesses, allowing classes to continue without interruption to the learning program.

Challenges included the finding that team teaching requires a great deal of planning time. Most teachers confirmed that additional planning time was needed to identify and establish individual roles within the team before effective planning could commence. These spaces forced teachers to reconsider how team teaching is best undertaken in them.

Effective team teaching appears to pivot on the ability of teams to construct and maintain strong, functional relationships. These relationships appear to underpin a teams’ ability to deal effectively with both the task and contextual variables, which they appear well skilled to attend to when supported by each other.

It was difficult to be heard when teaching in these spaces because of audible interference from nearby classes. Investing heavily in sound-dampening panels markedly reduced but did not eliminate noise from adjoining classes.

### effective integration of technology

Fisher discusses technology-enabled active learning environments. He examines technology-based active learning environments and suggests a blended learning matrix combining face-to-face physical and online learning. This is made possible through a variety of mobile communication devices. Fisher discusses the genesis of technology enhanced learning environments when it was introduced at MIT in 2003, that emphasises acoustics, furniture, lighting, mobility, flexibility, air temperature and security enhanced learning spaces ([Fisher, 2010](#_ENREF_16)).

### embracing a growth mindset

None of the literature related the teaching in ILEs to the growth mindset literature. Instead, the literature was focused on developing teacher’s abilities to make best use of the spaces for their teaching needs.

The following factors were found to have a positive impact on professional development and the pedagogical support experienced by teachers in ILEs:

* Teacher mentoring programs
* Teacher access to information and/or examples of pedagogies
* The presence of school leaders as teachers in the learning environments
* The type and range of opportunities that teacher have to participate in discussions/feedback about the desired pedagogies with school leaders
* Timetabling classes to positively reinforce the potential to implement particular pedagogies ([Cleveland et al., 2016](#_ENREF_10))

### community connections

None of the literature discussed community connections explicitly

## Guiding question 4: How can I help my students to transition to an innovative learning environment?

In the same way we suggest that professional learning for teachers should be focused on pedagogy, we extend this consideration to students – by providing them with guidance in the sort of pedagogies that will be implemented in ILEs.

One study reports on the four student practices that operate in ILEs: learner autonomy, group learning, revising acceptable behaviours, and fluid relations between students and teachers ([Chapman et al., 2014](#_ENREF_6)). These are described below with additional thoughts that relate to other concepts raised in this paper.

ILEs are predicated on fostering a sense of autonomous learning in students, which was found to create problems for some students to manage their own behaviours (no stable desk, constant changing between work groups, mobile learning). This autonomy is often regulated by the realities of the “structures” governing classroom life in the form of curriculum and timetables.

In relation to group learning, students need to be introduced to collaborative work practices explicitly; just as with teachers using these new spaces, it can’t be assumed that students automatically know how to learn and behave effectively. As such, consideration should be given to pedagogically-irrelevant factors that may arise as students are required to navigate and negotiate working in groups.

The acceptable behaviours of ILEs are likely to be different to those of traditional classrooms in relation to interruption, distraction and bodily proximity. These can present overwhelming environments in which students need to retreat to quiet isolated spaces just to able to work. This finding suggests the need for teachers to differentiate parts of the learning space, such as through the use of archetypal furniture arrangements presented in Table 4. These spaces can be used to communicate intended behavioural norms and expectations to students, as well as to communicate the different learning activities that they can engage in to achieve the learning outcomes intended of each task.

The fluid relations between students and teachers might challenge the prevailing relationships of students to a single teacher and brings up issues of responsibilities. Teachers working together should establish responsibilities for students and communicate these to them such that students feel comfortable accessing help and support for their learning when needed.

# Conclusions and recommendations

It is important that ILEs and learning spaces in general not be seen as neutral “containers” in which learning happens unquestioningly and uniformly ([Mulcahy & Morrison, 2017](#_ENREF_25)). Learning spaces, like all the spaces we inhibit are embodied and culturally laden with meanings about work, identity and action, resulting in the production of particular types of subjectivities. These subjectivities construct particular “types” of students ([Chapman et al., 2014](#_ENREF_6)) and teachers ([see, for example Cox & Edwards, 2014, discussing the "sphere of influence"](#_ENREF_11)). The understanding of space as being reflexive, in that it exhibits a bi-directional relation between the activities in the space and the space responding to them ([Cleveland, 2016](#_ENREF_7)) is critical.

Several studies have demonstrated that in conditions of uncertainty generated when the learning space drives pedagogy rather than being used as a tool for pedagogy, and in conditions where teachers sense that they are being observed by others, this can lead to overly rigid, unsuccessful and unresponsive pedagogies ([Saltmarsh et al., 2014](#_ENREF_30)). Instead, teachers should be well-versed in a range of pedagogies to be able to identify which of them is most suited to achieving their learning goals. Starting here – with professional development for the enhancement of teacher’s pedagogical repertoire – should then lead to teachers being introduced to the spatial literacy skills that they need to be able to carry out these pedagogies. The literature is not explicit about the way in which these spatial literacy skills can be developed.

Given the feasibility of employing constructivist pedagogies in these new spaces, some researchers have promoted the idea of *constraining* spaces in order to coerce teachers into this mode of teaching – this sentiment has been expressed both at the secondary ([Cleveland, 2016](#_ENREF_7); [Cleveland et al., 2016](#_ENREF_10)) and tertiary ([Hall, 2013](#_ENREF_18)) education levels. We consider that the design of spaces to encourage particular pedagogies, such as an exclusive reliance on constructivist pedagogies is a misdirected goal of the design of innovative learning environments. We present a framework through which teachers can identify the space most suited to their pedagogy of choice.

We consider that particular arrangements of teachers in space should also be a professional matter to be negotiated between teachers. The structure presented by Bradbeer ([2015](#_ENREF_5)) can have potential influence in addressing the non-spatial notions of proximity that arise when teachers use open spaces, such as type E spaces.

We question whether the cost and time required to negotiate these forms of proximity (an overwhelming preoccupation of users of such spaces), outweighs the potential benefits of using these spaces. In all spatial settings, consideration needs to be given to reducing pedagogically-irrelevant factors which place unnecessary exigencies on the work of teachers and students.

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