Innovative Learning Environments the good, the bad, and the ways to get them working

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ABSTRACT

In New Zealand and Australia, we are about ten years into a renaissance of 'open plan classrooms'. In contrast to the failed experiments of the 1970s, there is now greater (but by no means universal) optimism that these new Innovative Learning Environments (ILEs) can be made to work. This paper sets out the known acoustical challenges that arise in ILEs and how they can be overcome. However, even an ILE with the best acoustic design must still be set up and used in an appropriate way, if it is to work in practice. A collaborative approach to design is needed as well as school managers and teachers understanding the benefits and limitations of these spaces and how best to use them in practice.

1. INTRODUCTION

This paper is intended to be an expression of current thinking around modern classrooms, from the point of view of an acoustic consultant involved in research, design, review and policy development for these spaces. While there is some reference to research and international trends, it focuses on the current situation in New Zealand and Australia in terms of holistic learnings and understanding of the many aspects of classroom design.

One of the most important messages we aim to convey is that even if a modern classroom has ideal acoustics, it will still fail unless it is set up and used in the appropriate way. This means two things:

- The various design aspects simply cannot be progressed independently. There must be a collaborative and even-handed approach towards all design aspects, as the consequences of getting this wrong in learning spaces are perhaps more severe for the end users (teachers and pupils) than in other building types
- There is a need to educate school managers and teachers so they understand the limitations of these spaces and how to make use of their benefits. This is not an acoustical issue per se, but the acoustical design will be seen as deficient unless teaching and management practices that are suitable for the space are adopted

There are many pieces to this puzzle and while we understand what the picture should look like now more than ever, the stakes are high: we need to ensure effective education environments for future generations. It is hoped that this paper contributes to the effective design and use of these spaces, by setting the scene for architects, policy makers, educationalists, teachers and acousticians, so that we move forward with a common understanding of how new classrooms need to be designed, how renovations of existing classrooms should be approached, and most importantly, how these spaces should be used in practice.

2. WHAT'S IN A NAME?

They were once called 'open plan classrooms', but this term is no longer popular, particularly amongst those who favour them. The naming trends have weaved through the waters of 'co-operative learning spaces', 'shared classrooms', 'team teaching spaces', 'learning hubs', 'modern learning environments', and various other terms with their own acronyms and initialisms.

At the time of writing this paper, they are called Innovative Learning Environments (ILEs). ILEs are analogous to a classroom block (using older terminology) and are home to a number of sub-spaces including teaching spaces, break-out spaces, resource rooms, libraries, technology and science classrooms, bathrooms and outdoor learning environments.

Key among these are Flexible Learning Spaces (FLSs) which is the new term for open plan classrooms). They typically cater for 2–4 class units (up to 120 pupils), who may all occupy the space simultaneously yet be using it in different ways. Teachers plan their lessons together and during class, adopt a guidance role, assisting the pupils in their self-directed learning. This learning can be undertaken in a multitude of ways, and in a multitude of areas

within the FLS (or within the wider ILE), using a multitude of resources and technologies.

This is why the word *flexible* is a critical part of the new terminology; modern classrooms must be flexible to suit the full range of learning activities. Indeed, recent research has shown that a dynamic and customizable learning environment leads to better learning outcomes (Byers & Imms, 2016). However, the problem is that the desire for flexibility can introduce unwanted variables (e.g. visual and acoustic connection between activities) that need to be managed. After all, it's our children we're talking about here.

3. THE DESIGN CHALLENGES

3.1 Acoustic

Acoustic challenges for learning spaces are well known and have existed for many years in both traditional cellular classrooms and ILEs. The paramount acoustic requirement is an ambient sound level which is suitable for the learning method. Occasionally, higher ambient levels may be appropriate, or at least have little effect over the learning stream (i.e. during multi-media or physical education based activities), but when the time comes for communication and concentration the ambient level must be able to reduce accordingly.

A number of acoustic factors have an effect on the ambient sound level, such as:

- Reverberation time (RT) – which can exacerbate classroom activity noise via the café effect
- Sound insulation between learning spaces – both airborne and impact (particularly footfalls)
- HVAC sound levels
- Technology sound levels – IT equipment (computers, projectors etc.)
- Intrusive sound levels – from outside the space (other learning spaces, sports fields, traffic, aircraft, property maintenance etc.)
- Rain noise

In ILEs, some of these factors – particularly RT and sound insulation – are exacerbated because of the large floorplates and general absence of dividing walls. The basic tools for controlling these factors (sound absorption and sound insulation) are essentially the same now as they have always been, notwithstanding that there are more acoustic products on the market now, which improves the palette available to architects and designers. Achieving the best outcome is a careful balance between performance, cost and aesthetics, but as discussed in Section 4.2 there are some acoustic non-negotiables.

3.2 Non-acoustic

A functional ILE requires more than just good acoustic design. Lighting, heating, ventilation, ergonomics, energy efficiency and other factors must all be considered and integrated at an early stage of the development.

Interestingly, a functional ILE requires more than just good acoustic design even to have good acoustics. This was not necessarily the case for traditional cellular classrooms which relied primarily on a low ambient sound level and RT. Tick these two boxes and, acoustically speaking, the space would work well for learning.

For an ILE, ticking these boxes is not enough because learning areas have direct lines of sight and sound to each other, so unwanted noise can occur more readily. For example, a class unit doing a quiet concentration-based task can become distracted visually and/or aurally by activity in other parts of the ILE, so other control measures must be in place before the acoustic design can shine through.

3.2.1 Teacher buy-in

A third and equally important challenge in the effectiveness of ILE design relates to teacher involvement. ILEs exist primarily to support changes in pedagogy (Osborne, 2016) yet if teachers do not embrace and utilise these new methods then the openness of the space tends to clash with them. Currently, the majority of teachers have little say in management decisions relating to school property, but more importantly they are often simply provided with a space to teach in, and no information is provided about the implications/justification for ILEs nor how best to utilise them.

A recent study in New Zealand by Leggett (2016), which included a questionnaire investigating teachers' experiences in ILEs, showed that they expressed frustration about not being sure how to make best use of their new classrooms.

We believe the solution involves a two-step process:

1. Firstly, teachers must understand and embrace the concept behind ILEs
2. Secondly, they must be informed about how to use them effectively

To emphasise this reality, during a 2011 tour of Hellerup Sköl in Denmark (one of the first schools to exemplify the modern ILE movement) the principal indicated that within the first year of the school opening, 30% of the teaching staff had left (Whitlock, 2012). This indicates a rather harsh 'out with the old…' aspect to the rollout of ILEs, which begs the questions: *Are enough resources being put into training existing teachers how to use ILEs?* And *Are student teachers being taught how to make dynamic use of ILEs as part of their training?* In New Zealand at least, the answer to both questions seems to be no.

3.2.2 Space

In an FLS, acoustic absorption by itself can only provide so much benefit in terms of controlling noise transfer between activities. Without walls to block sound travelling between learning areas, distance must be available to make up the balance.

As we will establish in Section 4.2.1, the use of acoustic treatment on ceilings and walls should be maximised. However, it is important to note that the benefits provided by this treatment diminish if the room is overcrowded. This is because, in a group work activity for example, the number of talkers increases and the distance between each talker decreases. So, for a given receiver, the direct sound from each talker dominates over the reverberant sound field, and acoustic absorption only benefits the reverberant field.

The revised *DQLS – Acoustics* document recommends 3–4m^2 net floor area per pupil and this is sufficient to enable the space to 'breathe'.

Furthermore, with ILEs there are benefits in having a high ceiling because it adds extra treatable wall area, and further avoids possible 'acoustic claustrophobia'.

3.2.3 Space management

Because ILEs house a multitude of varied learning spaces, the school day must be streamlined to avoid activities clashing. For example, half the pupils should not be engaged in a musical/cultural performance if the other half are sitting a maths test. These sorts of clashes are more likely to happen in an ILE than a traditional cellular classroom so the teaching team must plan their lessons to avoid them.

Lesson planning is of course a key part of a teacher's skill set already, but managing the use of their learning space in conjunction with the other teachers in their team here becomes critical in an ILE.

3.2.4 Shape

Another factor that relates to both space and its management is the configuration of different spaces being used. The floor plan layout of an ILE can have a significant bearing over avoiding (or creating) acoustic issues – particularly the way various sub-spaces are positioned and connected to one another. For example, having a shape with internal corners allows visual and acoustic separation, which can be essential for some teaching methods.

Conversely, a simple rectangle offers little in terms of flexibility because every activity can see every other activity, and should therefore be either broken up with partitioned rooms such as break-out spaces, resource rooms, bathrooms etc., or by modifying the footprint itself. Accordingly, asymmetry and angled walls are generally beneficial as they break up room modes and potential reflection paths.

An example is shown in Figure 1.

Note that the FLS label in the figure appears limited to the red area, but in actual fact the other connected areas shown (labelled as making space, reflection space and library) are part of that FLS too, so could change as needed.

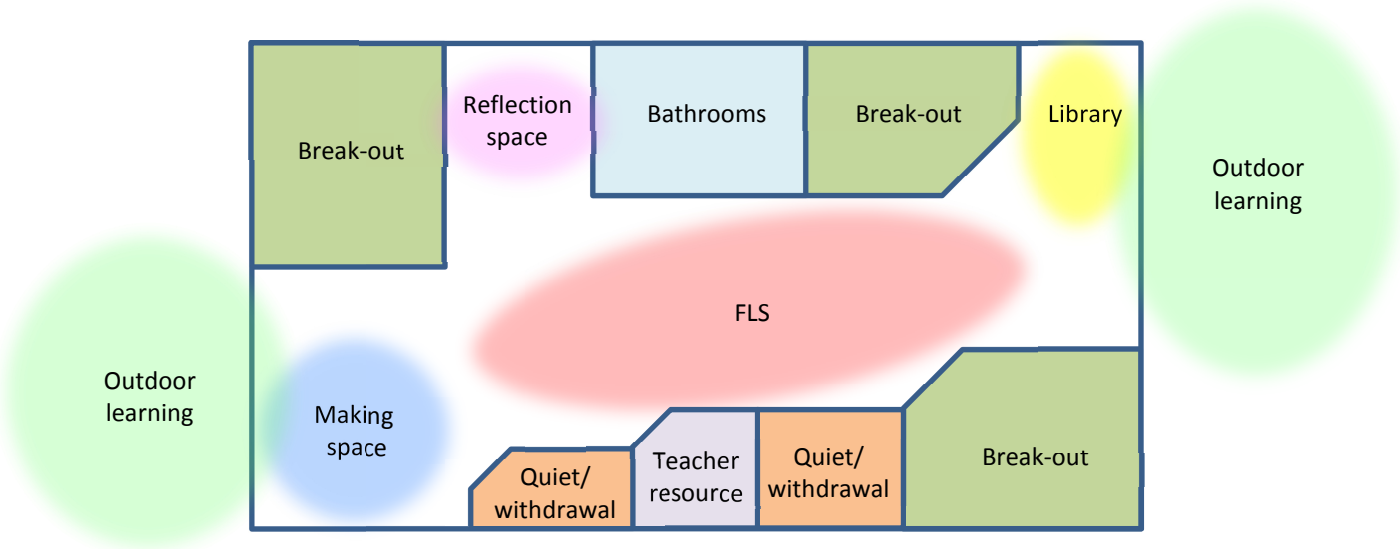

Figure 1: Example of a rectangular ILE shape, using an asymmetrical floor plan to 'break up' the space

Of course, having control over an ILE's footprint is fairly straightforward in new builds. Conversions of old (usually rectangular) teaching blocks however require careful consideration of ways to break up their shape. For example, instead of demolishing an entire wall, it can be beneficial to leave wing walls in place to create nooks and reading spaces, or lintels to break up potential ceiling reflection paths.

3.3 Public perception

The public perception of ILEs is mixed. Reports (Gerritsen, 2015 and McCance, 2015) indicate that feedback from principals, teachers and parents is divided, with some vehemently for and against. Their opinions are likely formed by what they have experienced at their own school, and as discussed above, there is little organization regulation with how schools are introduced to ILEs.

The rollout of ILEs in New Zealand began around seven years ago, having been prompted by a series of OECD research studies (OECD, 2008). The Ministry of Education quickly embraced the ILE concept and began putting policy in place to promote them including their 'Ten Year Property Plan (10ypp)' initiative (Ministry of Education, n.d.) which required that new school buildings follow the ILE concept, and that modifications to existing blocks should also follow that trend.

By around 2010 the Ministry was only offering funding only to build ILEs, so schools were all but obliged to adopt them. This, in the eyes of many, put the cart before the horse and it has taken some time for relevant experts in the sector (including acousticians) to catch up.

In 2007 the Ministry developed a series of design guideline documents called the 'Designing Quality Learning Spaces' series – one of which focused on acoustics (Ministry of Education, 2007). At the time of writing this paper, an updated version of *DQLS – Acoustics* is going through its final revisions, and unlike its predecessor it contains guidelines relating specifically to ILEs. This document will help to fill somewhat of a void in NZ documentation on ILE acoustics and hopefully act as a touchstone for both experts (designers, educators, acousticians) and the general public (parents, politicians) to reach a common understanding.

4. THE RIGHT RECIPE

4.1 Collaborative design

The single most important aspect of designing an ILE is collaboration. As mentioned previously, even an ILE with perfect acoustics will not be fit for purpose if other aspects are deficient, and the converse is true also.

This means that experts from each discipline cannot proceed individually and there needs to be an understanding and appreciation for this in order to reach common ground. Some measure of compromise is required from every facet of the design process, and the number of issues with rigid, exclusive requirements should be kept to a minimum.

The boiled-down essentials for acoustics are discussed in the following sections.

4.2 Acoustic essentials

4.2.1 Absorption on every available surface

The recommended RT for conventional primary school classrooms is 0.4–0.5s (Australia and New Zealand Standards, 2000) but it is impracticable for FLSs to achieve an RT this low, because the surface area needed for acoustic absorption is simply not available.

In most cases, treating every available surface (ceiling, walls and floors) is enough to provide reasonable outcomes. This is a simple rule of thumb for designers to remember and removes the need for an acoustic consultant to be engaged in 'designing' the RT of each and every FLS.

In the UK, Building Bulletin 93 requires <0.8s for 'Open-plan teaching areas' (Department for Education and Skills, 2015). This is a worthy design goal, but if the geometry of the space renders it impracticable (without expensive, bespoke acoustic solutions) there is little that can be done, and the rule of thumb should suffice.

- The ceiling is the most effective place for acoustic absorption. Products with NRC greater than 0.85 and a reasonable low-mid performance (i.e. thick panels around 50mm with a 35kg/m^2 density) are recommended
- Wall surfaces below 2 metres can serve the dual purpose of acoustic absorber and pinboard. There are many product options on the market for this use
- Wall surfaces above 2 metres are best treated with thicker products, such as those used on the ceilings. Treating all wall areas also helps to suppress long path-length reflections, mitigating the likelihood of echoes
- Floors should be carpeted except around wet or messy areas where a more cleanable surface is required

4.2.2 Break-out rooms

Break-out rooms are essential to the flexibility of ILEs. They should be large enough to house an entire class unit and have closable doors to any adjacent FLS. This enables at least one group to engage in quiet or didactic activities whilst limiting distraction from any activities occurring in the FLS. Ideally there should be a break-out home room available for each class unit, although this may not be achievable in some cases.

As visual connectivity is an important element of ILEs (Ministry of Education, 2016), dividing walls and doors of break-out rooms are often made of glass. But because glass cannot be treated (as yet) to suppress acoustic reflections, these walls and doors should be positioned and oriented carefully to avoid reflections from hard surfaces opposite.

4.2.3 Movable screens

Movable screens are often considered a furnishing element rather than part of the room itself, but they add a great deal of flexibility to an FLS. They can be acoustically absorptive or reflective (or one on each side), and are used to:

- Create reading nooks
- Surround a didactic learning session – acting as both an acoustic barrier to the adjacent space and (if reflective) as a reflector to support the early energy in speech, improving intelligibility
- Break up reflections between hard surfaces (if absorptive)
- Add extra absorption to the overall space (if absorptive)

Figure 2: Examples of movable screens (source: Ministry of Education NZ, 2016)

Note that screens should not be relied upon to fix acoustic shortcomings in a FLS. The design should be robust in the first place, and these screens provide added flexibility.

4.3 Teaching the teachers

This is not an acoustic requirement, but teachers' knowledge of how to use (and not to use) an ILE is so critical that it has been listed here again for emphasis.

Putting a group of teachers and pupils in an ILE and expecting them to figure it out is simply not good enough. In an ILE there are certain acoustic pitfalls and, as discussed in Paragraph 3.2.1, teachers must be made aware of this and provided with the tools to adjust their methods to suit.

Currently, education for teachers in this regard seems to be lacking, however there are a growing number of education consultancy services who are the key to bridging this gap. In New Zealand the revised *DQLS – Acoustics* document will also assist with improving the knowledge base also.

5. CONCLUSION

Innovative Learning Environments are very important spaces to get right. When designing them, consideration must be given to a number of factors, including acoustics, but the overall approach must be holistic.

After a rocky start to the wholesale introduction of ILEs to New Zealand schools, policy and guidance is starting to catch up, which will foster a better understanding of the challenges, and ways to overcome them.

This is easy to say, but it can be very difficult to achieve in practice. It requires knowledge (read: upskilling) and understanding from every person involved, in particular buy-in from teachers who *must* adapt their teaching styles to suit. Adaptation will be made easier if they know what to expect from flexible learning spaces, and how to use them to their potential. This is the realm of education consultants – who should be engaged for every ILE project (new builds and conversions alike).

Good acoustic outcomes rely on more than just good acoustic design. Extra care, understanding and most importantly collaboration is needed to create flexible and nurturing learning environments.

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